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RURAL HOSPITAL SYSTEM AFFILIATIONS AND THEIR EFFECTS ON  
HOSPITAL ECONOMIC PERFORMANCE, 2004-2008

A dissertation submitted in partial fulfillment of the requirements for the degree of  
Doctor of Philosophy at Virginia Commonwealth University.

by

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## LIST OF ABBREVIATIONS

ADMTOT	Total Admissions
AHA	American Hospital Association
ALOS	Average Length of Stay
AMC	Academic Medical Center
AMI	Acute Myocardial Infarction
ARF	Area Resource File
BBA	Balanced Budget Act
BBRA	Balanced Budget Reconciliation Act
BIPA	Benefits Improvement and Protection Act
CAH	Critical Access Hospital
CBSA	Core Based Statistical Area
CHS	Community Health Systems
CMS	Centers for Medicare & Medicaid Services
CRS	Continuous Returns to Scale
DEA	Data Envelopment Analysis
DMU	Decision Making Unit
DRG	Diagnosis Related Group
FIPS	Federal Information Processing Standard
FLEX	Rural Hospital Flexibility Program

FTE	Full Time Equivalent
HCA	Healthcare Corporation of America
HCRIS	Healthcare Cost Report Information System
HIT	Health Information Technology
HMO	Health Maintenance Organization
ICU	Intensive Care Unit
JCAHO	Joint Commission on the Accreditation of Healthcare Organizations
MDS	Minimum Data Set
MedPAC	Medicare Payment Advisory Commission
MMA	Medicare Modernization Act
MSA	Metropolitan Statistical Area
NLE	Non-Labor Expenses
OLS	Ordinary Least Squares
OMB	Office of Management and Budget
PPS	Prospective Payment System
RRC	Regional Referral Center
SARFIT	Structural Adaptation to Regain Fit
SFA	Stochastic Frontier Analysis
SUROPTOT	Total Hospital Surgical Procedures
VEM	Emergency Room/Department Visits
VOTH	Other (Non-Emergent) Outpatient Visits
VRS	Variable Returns to Scale

## ABSTRACT

RURAL HOSPITAL SYSTEM AFFILIATIONS AND THEIR EFFECTS ON  
HOSPITAL ECONOMIC PERFORMANCE, 2004-2008

By Mark Doughton Swofford, Ph.D., MHA, FACHE

A dissertation submitted in partial fulfillment of the requirements for the degree of  
Doctor of Philosophy at Virginia Commonwealth University.

Virginia Commonwealth University, 2011

Major Director: Stephen S. Mick, Professor, Department of Health Administration

The formation of multi-hospital systems represents one of the largest structural changes in the hospital industry. As of 2008, system affiliated hospitals outnumbered stand alone hospitals 2511 to 2167 and the percentage of system affiliated rural hospitals has increased dramatically from 24.8% in 1983 to 42.2% in 2008 (based on AHA data for non-federal acute care general hospitals). The effects of system membership on hospital performance have been of great interest to health care researchers, but the majority of research on multi-hospital systems has either focused exclusively on urban facilities or pooled urban and rural facilities in the same sample, and thus failed to allow for potential differences in membership effects between urban and rural hospitals. The result is that the effect of system membership on rural hospital performance has remained largely unexplored, creating a gap in the body of health services research.

The objectives of this study are both theoretical and empirical. Theoretically, this study is intended to be a deliberate empirical application of contingency theory, which is

the one major organizational theory that seeks to explain variations in organizational performance as its fundamental purpose. Empirically, this study seeks to explore the relationship between rural hospital system membership and rural hospital performance, taking into account the environment of the rural hospital and the structure of the multi-hospital system to which it belongs.

The study sample consists of 1010 non-federal, short-term, acute care general rural hospitals with consistent system membership and critical access hospital (CAH) status from 2004 to 2008. Hospital economic performance is represented by the dependent variables of hospital total margin and a productive efficiency score calculated using Data Envelopment Analysis (DEA). Four contingent pairs containing measures for environmental munificence, system membership, the presence of local system partners, the presence of hierarchical system partners, and CAH status, were used to measure a hospital's fit between environment and structure. Regression analysis was used to determine the relationship between hospital performance and the fit between a hospital's environment and its organizational/system structure. Results of the analysis indicate that hospitals with a better fit have significantly higher total margins, but results for productive efficiency were largely insignificant.

Given the lack of research focused on the effects of rural hospital system membership and the infrequent use of contingency theory in recent health services research, this study offers important findings and methodological examples to the field of health services research.

## CHAPTER 1 - INTRODUCTION

### The Study Problem

The evolution of rural hospitals from stand-alone facilities predominantly owned by local government organizations to the increasingly system-affiliated facilities that exist today is largely a story of resource munificence. When the Hill-Burton Act made resources plentiful after World War II, the number of rural hospital foundings increased dramatically (Williams & Torrens, 2008) and as resources diminished during the 1980s and 1990s, a large number of rural hospitals either closed (Drain et al., 2000; Ozcan & Lynch, 1992; Lynch & Ozcan, 1994) or entered into inter-organizational relationships to increase their access to scarce resources (Moscovice & Stensland, 2002b). These inter-organizational relationships included contract management agreements, network affiliation, and merger with or acquisition by multi-hospital systems. And while the development of such inter-organizational relationships has been well reported (Alexander & Morrissey, 1987; Mick et al., 1993; Mick & Morlock, 1990; Yarbrough & Powers, 2006), the effects of these changes in organizational form, specifically multi-hospital system membership, on rural hospital performance are not clear.

The formation of multi-hospital systems represents one of the largest structural changes in the hospital industry. Formed largely through mergers and acquisitions, whose rates peaked in the mid-1990s (Cuellar & Gertler, 2003), hospital systems may



significantly affect member hospital performance by providing greater management expertise, access to capital, improvements in health information systems, and rationalization and consolidation of services. As of 2008, system affiliated hospitals outnumbered stand alone hospitals 2511 to 2167 (based on 2008 AHA data for non-federal acute care general hospitals), and the effects of system membership on hospital performance have been of interest to health care researchers. However, the majority of research on multi-hospital systems has either focused exclusively on urban facilities (Trinh et al, 2010; Dranove & Shanley, 1995; Rosko & Proenca, 2005; Rosko et al, 2007) or pooled urban and rural facilities in the same sample (Cueller & Gertler, 2005; Melnick & Keeler, 2007; Bazzoli et al., 2000; Carey, 2003; Capps and Dranove, 2004; Chumaitov et al., 2009), and thus failed to allow for potential differences in membership effects between urban and rural hospitals. The result is that the effect of system membership on rural hospital performance remains largely unexplored. Therefore the purpose of this study is to address this gap in the literature by examining how multi-hospital system membership affects rural hospital performance.

#### Specific Aims of the Study

The objectives of this study are both theoretical and empirical. Theoretically, this study is intended to be a deliberate empirical application of contingency theory, which is the one major organizational theory that seeks to explain variations in organizational performance as its fundamental purpose. Empirically, this study seeks to explore the relationship between rural hospital system membership and rural hospital performance,

taking into account the environment of the rural hospital and the structure of the multi-hospital system to which it belongs. Both of these objectives are reflected in the specific aims stated below.

Several existing empirical studies of the relationship between multi-hospital system membership and hospital performance either use an indicator variable to designate system membership or use an existing typology to categorize the system relationships. The studies that use an indicator variable to represent system membership have failed to consistently find a significant relationship between system membership and hospital performance (Rosko et al., 2007). Considering that hospital systems vary in both strategy and structure, this is not surprising, and more recent studies use the Bazzoli et al. (1999) taxonomy to try and account for these differences in strategy and structure. Studies using this typology have found significant relationships between system membership / system characteristics and efficiency (Carey, 2003; Rosko et al, 2007), financial performance (Bazzoli et al, 2000), and quality (Chukmaitov et al., 2009). But most of these studies either focused exclusively on urban hospitals (Trinh et al, 2010; Dranove & Shanley, 1995; Rosko & Proenca, 2005; Rosko et al, 2007) or pooled urban and rural hospitals together (Bazzoli et al, 2000; Carey, 2003; Chukmaitov et al., 2009) and thus failed to allow for potential differences in membership effects between urban and rural hospitals. Further, it is unclear if the Bazzoli et al. (1999) typology, which was developed using data from both urban and rural hospitals, is appropriate for analyzing the effect of system membership on rural hospital performance. Although the Bazzoli et al.

(1999) taxonomy has been empirically supported by the results of several studies (Bazzoli et al., 2006), criticisms related to geographic dispersion and local clustering have been raised about the taxonomy (Luke et al, 2004), and there is evidence that rural hospital clusters are distinctly different from urban hospital clusters (Kania, 1993). Moreover, Hannan & Freeman (1977) argue against using fixed taxonomies, noting that categories should not be a priori, but should fit the research problem at hand. To this end the first specific aim for this study is to categorize the rural hospital systems and clusters.

**Specific Aim 1: Categorize rural hospital system affiliations based on geographic proximity to other system hospitals and differences in size / hierarchy of system hospitals.**

As noted by Alexander & Amburgey (1987), a good taxonomy will help reduce a complex data set to a more comprehensible and parsimonious form as well as facilitate hypothesis generation for empirical studies. Thus the intent of the first specific aim is not to criticize or refute existing taxonomies, but rather to categorize the rural hospitals in the sample solely based on differences in the structure of the multi-hospital system affiliations. Preliminary analysis of rural hospital data indicates that there are two important characteristics related to multi-hospital system ties. The first is geographic proximity to another hospital within the same system. Geographic proximity makes the coordination and centralization of logistic and clinical services possible. When a rural hospital is isolated, only administrative services (accounting, claims processing,

marketing, etc.) may be centralized, but when another system hospital is close, logistic services may be centralized (medical supply distribution, laundry service, etc.), and it becomes possible to coordinate and centralize clinical services as well. However, the centralization of clinical services also requires a hierarchy to exist between the proximate facilities – i.e., one facility needs to be a referral center for the other. Thus, the second important characteristic for the categorization is hierarchy, which means that a significant difference may exist between the rural hospital and another proximate system hospital in terms of scope of services and inpatient capacity.

Once the rural hospital system affiliations have been categorized, the next step is to use the categories to analyze the effect of rural hospital system affiliation on hospital performance. If system affiliated rural hospitals represent the creation of a new form of rural hospital through the mechanism of adaptation (Yarbrough & Powers, 2006), then, according to population ecology, the next process which should occur is the selection of one organizational form over another (Hannan & Freeman, 1977, 1989; Aldrich, 1999). This process should be evident in terms of hospital performance, because the organizational form that best “fits” the environment should outperform the other organizational forms. And there is some indication that system affiliated rural facilities may fit the rural environment better than stand alone facilities. In recent years for-profit rural hospital systems have reported large profit increases (Galloro & Piotrowski, 2002), and there is evidence that investor-owned chains are targeting rural facilities that essentially enjoy a monopoly-like position in their community / market (Greene, 2002).

However, not all rural hospital markets are the same; they may differ substantially in terms of important characteristics such as resource munificence and proximity to other rural or urban markets. Therefore, analysis of the effect of rural hospital system affiliation on rural hospital performance must use a theoretical framework that accounts for the degree of fit between the environment and the structure of the multi-hospital system. Contingency theory offers just such a framework.

**Specific Aim #2 – Analyze the effect of rural hospital system affiliation on rural hospital performance using a contingency theory framework to account for environmental and system differences.**

Contingency theory will be used to determine how well the structure of the multi-hospital system affiliation fits the rural hospital environment, and then the degree of fit between environment and organizational structure will be used to predict performance differences among hospitals. All else being equal, hospitals with a higher degree of fit should outperform hospitals with a lower degree of fit.

However, inter-organizational relationships are not the only significant adaptation in rural hospitals. Perhaps just as significant is the conversion of rural hospitals to Critical Access Hospitals (CAHs) under the Rural Hospital Flexibility Program (Flex program) that was part of the Balanced Budget Amendment of 1997. As of 2008, two-thirds of all rural hospitals had converted to CAH status, allowing them to receive cost based reimbursement from Medicare (2008 AHA data). This is a financial boon for rural

hospitals that qualify, and research shows that CAH conversion is associated with increased revenues, expenses, and margins (Li et al, 2009a), and that rural hospitals converting to CAH status increased their profitability more than other hospitals during the BBA implementation period (Younis, 2006). However, cost-based reimbursement has also hurt CAHs by removing the efficiency incentive inherent to the PPS system, and thus CAHs have been shown to have greater cost inefficiency than rural PPS hospitals (Rosko & Mutter, 2010). Ultimately, the conclusion that may be drawn from this literature is that CAHs are different from other rural hospitals, and thus CAH status must be taken into account when researching the effects of system membership on rural hospitals.

**Specific Aim #3 – Test whether CAH status moderates the effect of system affiliation on performance.**

To accomplish these specific aims, the proposed research will use a longitudinal non-experimental design to categorize the types of rural hospital system relationships that currently exist, and then examine the effect of system membership on rural hospital performance. Data will be collected from the American Hospital Association (AHA) hospital survey, the Area Resource File (ARF), and Medicare Hospital Cost Report Information System Minimum Data Set (HCRIS MDS) for all non-federal rural hospitals in the United States from 2004 to 2008. Financial performance and DEA-derived hospital efficiency scores will be used as the dependent performance variables to assess

the effect of system membership. Combinations of independent and control variables will be used in the analysis to address specific questions regarding the effect of hospital system type on efficiency, the effect of system type on financial performance, and the interaction of specific rural hospital structural features with system type.

#### Scope and Analytic Approach of the Study

The proposed study uses a non-experimental design with multiple cross-sections. The study population consists of all non-federal, acute care rural hospitals within the United States from 2004 until 2008, and for the purposes of this study, the term “rural hospital” includes all non-metropolitan statistical area hospitals (i.e. the sample includes both micropolitan and non-core/rural areas under the CBSA definitions). So from here forward all references to “rural hospitals” refers to hospitals in both micropolitan and non-core areas. The study links data from the AHA Annual Survey of Hospitals, the Medicare Hospital Cost Report Information System Minimum Data Set (HCRIS MDS), and the Area Resource File (ARF) in order to match organizational characteristics, environmental characteristics, and financial performance information for each rural hospital.

In contingency theory, specific organizational characteristics are not directly related to performance. Rather, organizational performance is attributed to how well an organization’s structure fits the nature of its environment, and performance differences among organizations may be explained by differences in “fit”. The organizational and

environmental characteristics taken from the AHA survey and the ARF will be used to calculate the degree of “fit” between the organizational structure and the environment.

This study focuses on economic performance, which is conceptualized as the financial performance and productive efficiency for each rural hospital. The financial performance measure will be taken directly from the HCRIS MDS, and the productive efficiency performance measure will be a DEA efficiency score calculated from variables in the AHA survey data. In accordance with Donaldson’s (2001) recommendations for empirically testing contingency theory relationships, there is a time lag between the dependent performance variables and the organizational and environmental characteristics. The measure of fit will be calculated using data from 2004 and the dependent performance measures will be taken from 2006, 2007, and 2008. Both ordinary least squares regression (OLS) and a Tobit regression model will be used to test the relationship between performance and “fit”. OLS will be used to regress financial performance on “fit” and a Tobit model will be used to regress productive efficiency on “fit”.

#### Significance of the Study

This study contributes to the body of health services research in several ways. First, on a theoretical level, this study is an empirical application of contingency theory. At one time, contingency theory was the dominant organizational theory for studying organizational design and performance (Tosi and Slocum, 1984; Drazin and Van de Ven, 1985; Scott, 1990), but it fell out of favor with organizational researchers in the mid-



1980s. Although contingency theory has not completely disappeared from health services research, it is difficult to find health care organizational studies that use it explicitly as the theoretical framework. The majority of studies either use another major organizational theory (resource dependence, transaction cost economics, and institutional theory appear often), choose to use micro-economic theory, or provide no theoretical framework. However, contingent thinking underlies a great deal of the work that is published about health services organizations and could benefit the field of health services research if it was used explicitly. This study is an attempt to use contingency theory explicitly, following the recommendations of its most ardent supporter, Lex Donaldson (1995, 2001).

Second, this study is meant to inform federal policy makers on the viability of rural hospitals and access to care in rural communities. Recent federal legislation (the Flex program) indicates that federal policy makers are interested in ensuring access to care for rural communities. In order to do this effectively, they must understand how system affiliations affect the viability of rural hospitals. The results of this study will help to indicate if system membership improves or decreases the financial viability of rural hospitals.

Finally, this study will begin to examine the interaction between multi-hospital system membership and CAH status. It is estimated that the CAH program costs the federal government \$1.3 billion in Medicare payments each year (Rosko & Mutter, 2010). This additional cost is the difference between what CAHs are paid under the

current cost-based reimbursement system and what they would be paid under the Prospective Payment System. This extra revenue is intended to ensure the continued operation of rural hospitals, but if system membership can achieve this objective by providing rural hospitals with greater access to critical resources, then the added expense of the Flex program may be unnecessary. Further, CAH status and system membership appear to influence hospital efficiency in opposite directions (Rosko & Mutter, 2010; Harrison et al., 2009; Ozcan & Luke, 1993; Rosco & Proenca, 2005), suggesting that system membership could restore the efficiency incentive that is lost when CAHs switch from PPS to cost-based reimbursement. If either of these cases is true, then policy makers may consider adjusting the Flex program criteria or the reimbursement levels to encourage or require system membership for CAHs. However, it is unknown how system membership interacts with CAH status. More information about the effects of system membership and the interaction of system membership with CAH status will help the federal government determine the appropriate certification criteria for CAH status and appropriately adjust the CAH reimbursement rates.

#### Organization of Subsequent Chapters

The remaining chapters of this study provide detailed information regarding previous literature that is pertinent to the problem, the conceptual framework for the study, the analytic methods used in the study, the results of the data analysis, and discussion of the results in the context of the stated hypotheses and conceptual framework. The subsequent chapters are organized in the following manner:

Chapter 2 summarizes previously published literature that is pertinent to the study problem, and identifies the gaps in the literature which are addressed by this study. Background information is presented on the development of rural hospitals in the United States, research and commentary on multi-hospital systems, and other empirical work on rural hospitals. Chapter 3 presents the conceptual framework for the study, and discusses how this framework was derived from contingency theory, constructs from Industrial Organization Economics, and the writings of Michael Porter on industry clusters and redesigning health care delivery organizations. At the end of Chapter 3 the hypotheses that are derived from the conceptual framework are presented. Chapter 4 presents the research methodology for this study. It includes the study design, the data sources for the study, the study sample, independent, dependent and control variable measures, and the analytical approach used to test the stated hypotheses. Chapter 5 presents the results of the analysis including both descriptive and inferential statistics. Finally, Chapter 6 discusses the results of the study within the context of the stated hypotheses and also comments on the theoretical implications of the study. At the close of the chapter, potential policy implications, study limitations, and suggestions for future research are offered for consideration.

## CHAPTER 2 – LITERATURE REVIEW

This chapter provides a summary of the literature on rural hospitals and multi-hospital systems that is relevant to this study. The chapter begins with some background information on rural hospitals and how they have evolved over the past century. Then rural hospital affiliations with multi-hospital systems and the conversion of rural hospitals to critical access hospitals are presented as important structural changes in the rural hospital population. Next, empirical studies examining the effects of multi-hospital system affiliation and CAH conversion on hospital performance are presented and discussed. The discussion on the effects of multi-hospital system affiliation begins with a review of research that has been done on hospitals in general, since most of the empirical literature does not specifically focus on rural hospitals. Then the discussion is narrowed to the writings and empirical work that examine system effects in rural hospitals. The literature on multi-hospital systems is then critiqued and summarized. Finally, empirical works on the effects of CAH conversion are presented, and the ways in which CAH conversion and system membership may interact are postulated. The chapter closes with a synthesis of the existing literature that identifies the gap which this study addresses.

### Background

#### *The Evolution of Rural Hospitals in the United States*

For the purpose of this study, rural hospitals are defined as those hospitals that are

outside of metropolitan statistical areas (MSAs). This is a common definition that has been used in health services research on rural hospitals (Cordes, 1983; Mick & Morlock, 1990; Reardon, 1996; Hart et al., 2005), and allows comparison of this study to previous work on rural hospitals. In general, rural hospitals are substantially smaller (107 vs 289 beds on average according to 2008 AHA survey data), are more likely to be not-for-profit (Wang et al., 2001b), have less access to capital (Alexander & Amburgey, 1987), have lower occupancy rates, and are more reliant on Medicare reimbursement (Cleverly, 1989) than urban hospitals. These differences are attributable to the conditions under which rural hospitals developed and the nature of the rural areas that they serve, which have higher rates of poverty, are less economically diverse, and have higher percentages of people over the age of 65 (Reardon, 1996).

At the beginning of the 20<sup>th</sup> century, rural hospitals were small proprietary organizations operated by a physician out of his home (Madison & Bernstein, 1976). Much smaller than urban hospitals, rural hospitals had a difficult time attracting physicians, and there was a noticeable quality difference between rural and urban hospitals. Urban hospitals were supported by larger populations of paying patients, had access to the latest technology, and benefited greatly from the Flexner Report, which consolidated control of medical education into large urban universities (Reardon, 1996). Rural hospitals could not compete with their urban counterparts, and many of them closed during the Great Depression. This trend would continue through World War II, until federal government intervention reversed the decline of rural hospitals.

The expansion of rural hospitals in the 20-year period after World War II (Alexander & Amburgey, 1987) increased access to medical care for rural communities, and created the infrastructure that delivers core medical services to the estimated 50 to 60 million rural citizens in the United States (Mick & Morlock, 1990; Hart et al., 2005). In many cases these rural facilities were built with federal matching funds made available by the Hospital Survey and Reconstruction Act of 1946 (more commonly known as the Hill-Burton Act) in communities that lacked sufficient resources to develop a hospital on their own (Torrens, 1980). Assistance under the Hill-Burton Act was limited to non-profit organizations; as a result the population of rural hospitals, which was largely proprietary prior to World War II, became predominantly non-profit (Reardon, 1996). Once constructed, these hospitals became symbols of community identity and pride (Ermann, 1990), and even though they lacked the size and patient volume of larger urban hospitals, cost-based reimbursement, national economic prosperity, and increased insurance coverage due to the creation of Medicare and Medicaid ensured the success and survival of rural hospitals through the mid-1970s (Reardon & Reardon, 1995).

However, in population ecology terms, the small size and generally limited scope of services of rural hospitals gave them a small niche width (Yarbrough & Powers, 2006) and made them vulnerable to changing levels of environmental resources (Hannan & Freeman, 1987). So as the cost of health care increased rapidly and the federal policy focus shifted from one of increased access to one of cost containment, rural hospitals were adversely affected. The creation of the Prospective Payment System (PPS) in 1983

and the emergence of managed care in the 1980s and 1990s lowered overall hospital reimbursement in an effort to encourage efficiency and hold down health care expenditures. These changes represented a decline in available resources for all hospitals, but significant differences between rural and urban hospitals made changes to health care financing particularly harmful to rural hospitals (Chan et al., 1999). The result was an unprecedented number of hospital closures in the 1980s and early 1990s that affected rural hospitals disproportionately (Drain et al., 2001; Reardon, 1996, Yarbrough & Powers, 2006).

Between 1980 and 1992, 389 rural hospitals closed (Reardon, 1996), and closure rates for rural hospitals were markedly higher (29% from 1985-1988) than those for urban hospitals (Drain et al., 2001). High rural hospital closure rates were very concerning to both federal policy makers and rural health care providers, and prompted several studies by health services researchers (Sager, 1983; Mayer et al., 1987; Williams et al., 1991; Ozcan & Lynch, 1992; Lynch & Ozcan, 1994; Slomski, 1995). Initially many of them hypothesized that rural hospital closure rates were related to Medicare and/or Medicaid payments (Sager, 1983; Mayer et al., 1987; Williams et al., 1991), hospital inefficiency (Ozcan & Lynch, 1992), or low profit margins (Slomski, 1995). However, those hypotheses were largely unsupported. It was determined that there was no difference in the efficiency of closed and open hospitals (Ozcan & Lynch, 1992), and that low profits were not a cause of closure, as many rural hospitals were actually more profitable than comparable urban facilities (Slomski, 1995), and results linking Medicare

and/or Medicaid payment shares to closure were mixed (Sager, 1983; Mayer et al., 1987; Williams et al., 1991).

The one consistent finding that did emerge from these empirical studies was that rural hospital closures were largely determined by hospital characteristics such as small size and low inpatient demand / volume. Ozcan & Lynch (1992) noted in their efficiency study that low inpatient demand (specifically discharges per bed of 21-22 or less) was linked to increased risk of closure. Expanding on this point, they note that the increased risk of closure remained even if hospitals maintained efficiency by cutting costs. This finding was supported by Slomski (1995), who noted that low inpatient volume--not low profit rates--was the primary factor related to hospital closure. Thus the increased vulnerability of rural hospitals to closure was primarily a factor of hospital characteristics like small size and low occupancy, which may be linked to overall environmental/area munificence in rural communities (Lynch & Ozcan, 1994) indicated by declining Medicare reimbursement, weak rural economies, aging facilities, and competition from nearby rural and urban hospitals (Trinh & Begun, 1999).

Faced with diminishing resources and the threat of closure, many constituencies questioned the role of rural hospitals and their financial viability in the future (Moscovice & Rosenblatt, 1985a). Researchers focused on the strategic activity of rural hospitals (Moscovice & Rosenblatt, 1985b; Smith & Piland, 1990; Mick et al., 1993; Trinh & Begun, 1999; Trinh & O'Connor, 2000), trying to discern what, if any, strategy could ensure their preservation. Although research at the time noted that the strategies



employed by the population of rural hospitals was not uniform, and strategic activity was absent in nearly one-third of rural hospitals (Mick et al., 1993), the perspective of time allows us to see the most widespread and beneficial strategies clearly. Often, changes in organizational strategy result in changes to organizational structure (Zuckerman, 1983), and indeed this is the case in the rural hospital population. The two most notable changes to rural hospital structure over the past 40 years are the increase in multi-hospital system affiliations and the conversion to critical access hospitals. These two strategic adaptations and their relationship to rural hospital performance are discussed in the next two sections.

#### *Rural Hospital Affiliation with Multi-Hospital Systems*

Multi-hospital systems are defined as two or more hospitals owned, leased, or managed by a single corporate entity (Mick & Morlock, 1990). They are distinct from hospital networks and other voluntary consortiums in that the hospitals are unified through some form of common ownership (Shortell, 1988; Bazzoli et al, 1999), and are generally identified as a horizontal integration strategy rather than a vertical integration strategy that involves linking organizations along the continuum of health care (Luke et al, 1995; Mick et al, 1993).

Early in the 1980s, affiliation with multi-hospital systems was identified as a potential strategy to improve the financial viability of rural hospitals (Moscovice & Rosenblatt, 1985b). During the period 1983 to 1988, over 69% of all rural hospitals pursued at least one horizontal or vertical integration strategy, with multi-hospital system

membership identified as one of the top strategies pursued (Mick et al., 1993). Descriptive studies revealed that system affiliations increased dramatically in the 1970s and 1980s, but these affiliations included a mix of common ownership (i.e., the rural hospital fully becoming a member of the system), leased facilities (where the system leases the rural hospital), and contract management arrangements under which the rural hospital retained greater autonomy (Lewis & Parent, 1986). Rural hospitals needed and wanted the resources that multi-hospital systems could provide, but were hesitant to completely trade their autonomy for access to these resources. Thus the majority of them initially entered into affiliations that were less constraining than common ownership. However, as economic challenges persisted and rural hospitals were disproportionately affected by the PPS (Smith & Piland, 1990), an increasing number of rural hospitals were willing to surrender their autonomy. This is evident by the percentage of rural hospitals that are members of a multi-hospital system. In 1983, 24.8% were part of a system (Lewis & Parent, 1986) and in 1994 that number had increased to 36.4% (Reardon, 1996) and has continued to increase in the current century with 40.7% part of a system in 2004 and 42.2% in 2008 (calculated from AHA data).

However, simply tracking the percentage of rural hospitals that are members of multi-hospitals systems does not tell the full story. It is also informative to examine the types of systems that are acquiring rural hospitals and the location of the rural hospitals that are most likely to be part of a system. First, the majority of systems that own rural hospitals are non-profit systems. Due to the restrictions of the Hill-Burton legislation,

rural hospitals built in the 20 years after World War II were predominantly non-profit institutions owned by either local government or religious entities. This remains largely unchanged today, when nearly 89% of all rural hospitals are non-profit institutions. Early system affiliations reflected this bias, and before 1980, secular and religious non-profit systems were the largest players in the rural hospital sector. This trend reversed itself for a short period, when in the 1980s the majority of new system affiliations were with for-profit systems (Lewis & Parent, 1986), but this trend did not continue. Today, out of all rural hospitals that are members of multi-hospital systems, slightly less than 25% are members of for-profit systems (calculated from 2008 AHA data). While this percentage is nearly twice as high as the percentage of rural hospitals that are for-profit, indicating that for-profit multi-hospital systems have made some inroads into rural markets, the vast majority of rural hospital system affiliations remain with non-profit systems.

Second, the likelihood that a rural hospital will be owned by a multi-hospital system differs substantially by geographic region and Office of Management and Budget (OMB) statistical area. Looking at the nine census divisions, rural hospitals in the Mountain division are most likely to be owned by a multi-hospital system and those in the Middle Atlantic and New England divisions are least likely to be part of a system (Reardon, 1996; Lewis & Parent, 1986). Although the percentage of rural hospitals belonging to a system has increased in each division over the past 30 years, the difference among divisions has remained consistent. Rural hospital system membership also varies by OMB statistical area, which may be seen by dividing the system owned hospitals into

OMB metropolitan, micropolitan, and non-core statistical areas. Looking at all of the non-federal general hospitals in the United States, there are 2,652 hospitals in metropolitan statistical areas, 846 hospitals in micropolitan statistical areas, and 1,180 hospitals in non-core areas (areas not designated as either metropolitan or micropolitan). Of these, 62.4% of the hospitals in metropolitan areas (commonly referred to as urban) are part of multi-hospital systems, 50.2% of hospitals in micropolitan areas are part of a system, and 36.4% of the hospitals in non-core areas are part of a system (calculated from 2008 AHA data). This clearly shows that multi-hospital systems are more active in areas with larger populations, and multi-hospital system affiliation is more likely for rural hospitals in micropolitan areas than for those in non-core areas. However, numerically the number of system-owned rural hospitals is virtually identical in micropolitan and non-core areas (425 to 430 respectively).

#### *Conversion to Critical Access Hospitals*

A more recent structural change in the rural hospital sector is the conversion of rural hospitals to critical access hospitals. Contained in the Balanced Budget Act (BBA) of 1997, the Rural Hospital Flexibility Program was created to prevent the closure of rural facilities and thus protect access to health care in rural communities (Dalton et al., 2003). The primary way that it accomplished this was by establishing the criteria for rural hospitals to be designated critical access hospitals (CAHs). Under the initial criteria in the 1997 legislation, rural hospitals had to be geographically isolated (35 miles by primary road or 15 miles by secondary road from another hospital), operate a full time

emergency department/room, operate no more than 15 acute care beds, and all patient stays had to be less than 96 hours, in order to receive CAH designation. In return, hospitals that qualify are reimbursed on a cost basis for Medicare patients instead of receiving PPS rates. This modification to reimbursement rates greatly reduced the financial uncertainty rural hospitals faced under PPS (i.e., that they had to meet average DRG costs with low patient volume) making this an attractive program to rural hospitals. Additionally, states were allowed to waive the geographic isolation requirement if they deemed a hospital a “necessary provider,” thus many more hospitals had an opportunity to participate in the program.

Subsequent legislation amended the qualification criteria allowing even more hospitals to participate in the Flex program. The Balanced Budget Reconciliation Act (BBRA) of 1999 changed the length of stay requirement to the average LOS of all patients (rather than each patient stay) must be less than 96 hours and allowed states to designate some urban hospitals as “rural” if they met all of the CAH criteria, thus some CAHs are actually located in MSAs. The Benefits Improvement and Protection Act (BIPA) of 2000 extended the cost-based reimbursement to cover on-call physician charges, and the Medicare Modernization Act (MMA) of 2003 increased the number of acute care beds a CAH can operate from 15 to 25, increased the cost-based reimbursement rate to 101% of costs, but also made the geographic isolation requirement stricter by removing the option for states to waive this requirement. This last change was effective in 2006, creating a deadline for many hospitals to convert to CAH status.

Initially, response to the Flex program was slow as hospitals waited for more information and implementation guidelines about the legislation. But after the first two years, participation in the program was tremendous, with over half of all rural hospitals converting to CAH status between 1999 and 2005 (MedPAC, 2005). However, the majority of CAHs did not meet the geographic isolation requirement (only 18% are more than 35 miles by primary road from another hospital) (MedPAC, 2005), and the stricter enforcement of this provision slowed conversion to CAH status when it went into effect in 2006 (MedPAC, 2006). Thus today the percentage of rural hospitals designated as CAHs is 51.8%, which is very similar to the figures in 2005.

Similar to system membership, the distribution of CAH conversions is not uniformed across the rural hospital population, and is skewed along both organizational characteristics and geographic location. The primary organizational characteristics that separate CAHs from non-CAHs in the population of rural hospitals are hospital size and Medicare payer mix. When measured by bed size, CAH hospitals are significantly smaller than non-CAH rural hospitals (Dalton et al., 2003). Additionally, rural hospitals that converted to CAH status have a higher percentage of Medicare patients than non-converting rural hospitals (61% to 49%, respectively) (Rosko & Mutter, 2010). Both of these differences are understandable considering that one of the criteria for CAH designation is to operate no more than 25 acute care beds, and the advantageous reimbursement CAHs receive applies to Medicare patients.

Geographically, CAHs are more prominent in the central census divisions and in non-core statistical areas (based on 2008 data). Looking at the nine census divisions, the West North Central division has the highest percentage of CAHs and the New England and Middle Atlantic divisions have the lowest percentage of CAHs. There is also a significant difference in the percentage of hospitals designated as CAHs in micropolitan and non-core areas. In micropolitan areas only 26% of all hospitals have converted to CAH status, while in non-core areas over 70% of hospitals have converted.

#### *Summary of the Background of Rural Hospitals*

Identified by their location in non metropolitan statistical areas, rural hospitals are primarily non-profit hospitals built with federal matching funds from the Hill-Burton Act and owned by local government or religious entities. Rural hospitals provide critical hospital services for approximately 60 million citizens across the United States, and thus their financial viability is important to ensure access to health care. As a group they enjoyed relative prosperity for the 30-35 year period after World War II, but began to struggle as federal health policy shifted focus to cost control. Implementation of the PPS affected rural hospitals disproportionately, and many of them struggled and closed during the 1980s and early 1990s. Financial uncertainty and the threat of closure lead to strategic action by rural hospitals and regulatory intervention by the federal government, the result of which was significant structural change to the population of rural hospitals. Since the mid 1980s, rural hospital affiliations with multi-hospital systems have increased markedly, and during the 1990s the federal government created the Flex program which

allowed rural hospitals to convert to critical access hospitals in order to receive more favorable reimbursement. Today over 42% of all rural hospitals are owned by a multi-hospital system, and nearly 52% of all rural hospitals have converted to CAH status. These are the two most significant structural changes in the rural hospital population in the past 50 years, and the effects of these changes deserve the attention of health service researchers. However, these changes did not occur uniformly across the population of rural hospitals. Significant differences in system membership and CAH conversion are apparent along organizational and environmental variables, which must be considered in empirical analysis of the effects of system membership and CAH conversion.

#### Empirical Studies on the Effects of Multi-Hospital System Membership

The concept of regional health systems that rationally organize medical care among multiple facilities dates back to the 1920s Dawson Report, which proposed such an organization for the British health system (Luke, 1992). The organizational concepts recommended in the Dawson Report are similar to those proposed for organizing health care systems in this country (Donabedian, 1972) and involve establishing a hierarchy of services and organizations in a “hub and spoke” configuration to serve a specific region / population. Such a system would have a large tertiary facility at the center offering a wide array of services including high technology and sub-specialty services. Smaller organizations are arrayed on the periphery of the system offering primary and secondary services to local residents. When more complex services are required, these smaller organizations refer the patients to the larger tertiary facility in the center. Such rational



organization of health services, which in most cases was conceptualized as the product of centralized planning (Luke, 1992), would prevent duplication of services, reduce excess bed capacity, and save cost for a centrally budgeted health care system.

In the United States, multi-hospital systems formed largely through mergers and acquisitions, the rates for which peaked in the mid-1990s (Cuellar & Gertler, 2003), are primarily a product of economic / market forces rather than centralized planning by government organizations. Comprised of a mix of religious, secular non-profit, and for-profit investor owned entities, the number of multi-hospital systems in the United States has grown rapidly since the 1960s (Alexander & Amburgey, 1987), and represents one of the largest structural changes in the hospital industry. Even though these multi-hospital systems were not centrally planned, it is possible that they can reduce the duplication of services and excess capacity in much the same manner as centrally planned systems. System advocates and some health services researchers believe that multi-hospital systems provide member hospitals specific advantages over free standing hospitals, which include an increased chance of survival and opportunity for growth, cost savings associated with economies of scale, and increased access to capital financing and human resources (Zuckerman, 1983; Moscovice & Rosenblatt, 1985b). Multi-institutional arrangements are thought to be particularly important for rural hospitals, the small size and limited service offerings for which make them particularly vulnerable to environmental changes (Yarbrough & Powers, 2006). However, the results of empirical research trying to show the advantages of system membership have not been clear, and

led some early system researchers to conclude that the promises of multi-hospital systems were unfulfilled (Shortell, 1988).

This section examines the empirical work on the effects of multi-hospital system membership. First, the body of literature examining multi-hospital systems and empirical works that analyze their effects on member hospitals are presented and discussed. Then, because the majority of recent work on system membership has been done on urban hospitals or hospital samples containing both urban and rural facilities, the discussion will be narrowed to focus only on those writings that address rural hospital system membership / affiliation. Finally, the work will be summarized and critiqued with emphasis placed on theoretical and methodological issues that will be addressed in this study.

#### *Multi-Hospital Systems and Their Effects on Member Hospitals*

In 1946, only 5% of hospitals belonged to multi-hospital systems, and all of these were Catholic or secular not-for-profit systems (Alexander & Amburgey, 1987). Then in the 1960s the first investor-owned multi-hospital systems appeared on the scene (Shortell, 1988), and by 1979 one-quarter of all hospitals were part of a multi-hospital system. Distinguished from health networks and other forms of strategic alliances by common ownership, the influence of multi-hospital systems has continued to grow, and the most recent AHA hospital survey shows that nearly 56% of all U.S. hospitals are part of a multi-hospital system (2008 AHA Annual Survey). This dynamic restructuring of the hospital industry has not escaped the scrutiny of health services researchers who have

exerted considerable effort trying to conceptualize and quantify how system membership affects the performance of individual hospitals.

Largely based on the ideas that system membership provides individual hospitals with improved financial and administrative management, gives them better access to financial capital, and creates economies of scale (Carey, 2003), research on system membership has posited that system hospitals should outperform non-system hospitals. However, early empirical work using a binary variable to represent system membership failed to produce consistent results (Rosko et al., 2007), and led to the conclusion that multi-hospital systems have not met expectations (Shortell, 1988) associated with greater efficiency, reduced costs, economies of scale, and the integration of patient care and clinical services (Zuckerman, 1979; 1983). This conclusion was primarily based on system research that used pre-PPS data and emphasized static system characteristics such as ownership, size, or regional location (Levitz & Brooke, 1985; Alexander & Shroer, 1985; Lynch & McCue, 1990; Coyne, 1985; Ermann & Gabrel, 1984), which Shortell (1988) felt were insufficient to truly capture the nature of multi-hospital systems. As an alternative, he proposed that researchers needed to focus on how systems functioned, which he referred to as “systemness”. The concept of systemness included factors such as common culture, integrated financial and strategic planning, centralized decision making and support services, a system wide quality assurance program, and integrated clinical services for systems that were geographically concentrated (Shortell, 1988).

Over the next decade, research on the effects of multi-hospital systems continued with some researchers continuing to do empirical work with a simple indicator variable for system membership (Dranove & Shanley, 1995; Dranove et al, 1996), while several others attempted to furthering the understanding of systems and how best to conceptualize them (Gaynor & Wilson, 1999; Alexander & Amburgey, 1987; Kania, 1993; Luke, 1992; Reardon & Reardon, 1995; Bazzoli et al, 1999). This conceptual work may generally be divided into two domains: attempts to categorize systems and create an over-arching taxonomy, and the study of local system clusters and partnerships.

Early attempts to categorize systems and create a taxonomy that would be useful for systems research were based on organizational characteristics like ownership and size (Alexander et al, 1985), while others divided systems into large numbers of categories and sub-categories (Lewis & Alexander, 1986) potentially too wieldy for researchers to use. These attempts at creating a comprehensive taxonomy were criticized for not capturing the essence of “systemness” (Shortell, 1988) and were not used widely by researchers. Then in 1999, Bazzoli et al. produced a taxonomy that divided hospital systems (and networks) based on their centralization, differentiation, and integration of hospital services, physician services, and insurance services. The constructs of centralization, differentiation, and integration were drawn from industrial organization economics and organization theory, and the primary method for creating the taxonomy was cluster analysis. The resulting taxonomy has five system types based largely on the centralization of services within the system (shown in Figure 1), and was adopted by the

System Type	Definition
Centralized Health System	Centralized systems centrally organize hospital services, physician arrangements, and insurance products.
Centralized Physician/Insurance Health Systems	These systems have centrally organized physician and insurance arrangements, but they exhibit only moderate centralization in the delivery of hospital services
Moderately Centralized Systems	Moderately centralized systems give more autonomy to member hospitals with regard to organizing hospital services, physician arrangements, and insurance activity. They are characterized by moderate levels of centralization for all types of services and arrangements.
Decentralized Health Systems	These systems are characterized by a high level of decentralization. System members provide a higher percentage of their services at the individual hospital level and are characterized by decentralized physician and insurance arrangements.
Independent Hospital Systems	Independent systems have little differentiation of hospital services, physician arrangements or insurance products. Centralization on all of these dimensions is low to moderate. Hospitals operate independently.

Figure 1 – Taxonomy of Hospital Systems (Bazzoli et al., 1999)

AHA for use in their annual hospital survey data base. Fellow researchers appreciated the conceptual and empirical rigor behind the taxonomy, and its inclusion in the AHA database made it readily available to researchers using secondary data. As a result, the Bazzoli et al (1999) taxonomy has been widely used for empirical research on hospitals and multi-hospital systems (Bazzoli et al, 2000; Bazzoli et al, 2001; Carey, 2003; Rosko et al, 2007; Chukmaitov et al, 2009).

Empirical work using the Bazzoli et al. (1999) taxonomy has produced significant results pertaining to the quality, efficiency, and financial performance of hospitals. Analysis of financial performance found that the financial performance of hospitals in moderately centralized systems was better than that of hospitals in centralized systems, but hospitals in systems with little differentiation and centralization of services had the poorest financial performance of all (Bazzoli et al., 2000). Work on hospital cost

efficiency using Stochastic Frontier Analysis (SFA), found that systems with centralized physician/insurance services and decentralized health systems were more efficient than the other types of systems (Carey, 2003; Rosko et al., 2007). Finally, empirical work analyzing the quality of care produced significant results indicating that centralized systems lead to better quality (Chukmaitov et al., 2009). So there is no clear consensus as to which type of system performs best across multiple performance dimensions, but empirical work using the taxonomy has consistently produced significant findings, which is a marked improvement from studies that use a simple indicator variable. However, the taxonomy has been criticized for aggregating market-level data about hospital and physician service sharing to categorize entire multi-hospital systems at the national level (Luke, 2006). Luke (2006) illustrates with some simple analysis that the taxonomy may simply be a measure of the geographic dispersion of the hospitals within a system, and advocates studying local system clusters, rather than relying on an over-arching taxonomy of systems.

A review of the Bazzoli et al (1999) paper which introduced the taxonomy reveals two reasons why the taxonomy may not be appropriate for this study. First, and most importantly, the taxonomy was developed using a combined sample of urban and rural hospitals, which may not accurately represent the rural hospitals within a given system. Although each system is unique, in general urban system hospitals outnumber rural hospitals two to one, and several systems consist of more urban hospitals than rural hospitals. The system type in the AHA data set (the variable cluster code) is assigned

using the methods and categories developed by Bazzoli et al (1999), which categorize system centralization by aggregating clinical service sharing, physician service arrangements, and insurance services at the system level. Systems which contain predominantly urban hospitals will reflect the degree of centralization and service sharing of the urban system hospitals and may not accurately reflect the reality of the rural system hospitals. An example of this is the categorization of the Healthcare Corporation of America (HCA). HCA is one of the largest multi-hospital systems in the nation, with 162 individual hospitals listed in the 2008 AHA data set. Of that 162, 148 of the hospitals are located in a metropolitan statistical area and only 14 of them are in rural areas. Thus the categorization of the system by the Bazzoli et al (1999) taxonomy would be almost completely determined by the characteristics of the urban hospitals within the system, and is not appropriate for studying rural hospitals which is the focus of this study.

Second, when the Bazzoli et al (1999) taxonomy measures service sharing; only the centralization of clinical services is considered and the centralization of logistic services, information technology, and other administrative services are not measured. Bazzoli et al (1999) assert that their measure of service sharing is a proxy for centralized decision making and service arrangements within a system in general, however a quick review of how some of the systems in the AHA data set are categorized raise concerns with this assertion. Multi-hospital systems such as Community Health Systems (CHS) and LifePoint Hospitals are categorized as decentralized systems (cluster ID = 4 in the AHA

data set), when in fact decision making within these systems is very centralized<sup>1</sup>.

Additionally, federal government hospital systems such as the Department of the Army Health System, the Veterans Affairs Health System, and the Indian Health Service are categorized as moderately centralized, decentralized, or independent respectively, when in fact these are highly centralized systems with fairly rigid command and control structures, and centralized information management, financial management, logistic, and personnel functions. So while the Bazzoli et al (1999) taxonomy may be correct in categorizing the centralization of clinical services within these systems, it does not fully represent the centralization of decision making and non-clinical services within a given system. The conceptual framework for this study posits that hospital efficiency and performance are not only affected by clinical service sharing which primarily occurs between hierarchical system partners, but also by the centralization of logistic and administrative efforts by local system partners. For this reason, the methods for this study do not include the use of existing taxonomies, but instead follow Luke's (2006) advice to focus on the characteristics of local system clusters, and how the presence or absence of local system partners and hierarchical system relationships affect rural hospital economic performance.

Local system clusters are groups of two or more hospitals owned by the same system that are in close proximity to each other. Sometimes referred to as local health systems (Luke, 1992) or locally concentrated systems (Cueller & Gertler, 2003), researchers who

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<sup>1</sup> This is based on personal discussions with CHS and LifePoint hospital CEOs and COOs at an American College of Healthcare Executives (ACHE) seminar in Williamsburg, VA during the summer of 2009.



analyze local system clusters note that geographic proximity creates clinical and strategic interdependence among hospitals (Luke, 1992, Alexander & Schroer, 1985).

Independent hospitals that serve the same area or have overlapping service areas compete for patients, bargain with the same employers and/or managed care organizations, and often offer duplicate services (Trinh et al, 2008), which are not used to capacity. When these hospitals are part of the same system, they may be managed as a cluster, which can lead to increased market power, the centralization of common services, the reduction of excess capacity, and the creation of economies of scale through clinical integration / consolidation (Kania, 1993; Gaynor & Wilson, 1999; Luke, 1992). However, the extent to which this occurs within a given system is not homogenous across different markets or localities; thus, each cluster of hospitals should be examined independently when performing research on multi-hospital systems. The hierarchical order among cluster hospitals (sometimes referred to as a parent-child relationship) and the geographic spread of the cluster (Luke, 1992) are important characteristics which may explain differences in performance.

The concept of clusters has also been advanced by Michael Porter (1998, pg 197), but in a much broader context, looking across industries and nations. Porter notes the potential strategic advantage that organizations may achieve by clustering in specific geographic areas. Although he primarily writes about clusters of organizations that bridge industrial sectors and involve multiple input / output relationships, same-industry clusters such as local hospital clusters are mentioned as a special type of cluster that

produce goods that are consumed locally (i.e., patient care in the case of hospitals). Whether or not clusters are comprised of diverse organizations or same-system organizations, when interrelated organizations cluster together in a given locality, they are able to capture the advantages of inherent interdependencies that come with shared production, distribution, and information exchange. The clustered organizations create a network, and the interests of individual organizations are combined to create shared interests and a sense of community where the frequency and impact of interactions is increased (Porter, 1998, pg 226). The result is that organizations that are part of a cluster gain a competitive advantage that may result in increased productivity, innovation, and economic value (Porter, 1998, pg 213).

Despite the potential benefits of local system clusters, the majority of multi-hospital system research has focused on multi-hospital system characteristics as opposed to those of the subunit clusters themselves, thereby leaving the effects of system clusters and local partners largely unexplored (Cueller & Gertler, 2003). This is especially important for the study of rural hospitals, many of which are inextricably linked to nearby, larger urban hospitals by patterns of patient referrals, patient transfers, and the phenomenon of out-shopping (when patients from a rural area skip their local hospital to seek care at a nearby urban hospital). Such localized rural-urban relationships may be evident when clusters are examined, but may not be reflected in studies that focus on system level characteristics, which may be highly influenced by the amount of service sharing among the urban hospitals in a given system.

Recent empirical work has attempted to fill this gap by examining the efficiency and financial performance of hospital clusters and/or member hospitals (Sikka et al, 2009; Trinh et al, 2010). Differences in efficiency may be attributed to the degree to which a local cluster resembles the regional health systems envisioned by the Dawson Report and other system advocates (Luke, 1992; Donabedian, 1972), exemplified by hierarchical order and the rational organization of clinical services (Sikka et al, 2009). Such configuration facilitates cooperative behavior like the sharing / receiving of clinical services, which is thought to affect individual hospital efficiency and financial performance (Trinh et al, 2010). Findings from these studies, while very preliminary, provide mixed results with regard to cluster configuration. For instance, Sikka et al (2009) found that hierarchy among cluster hospitals significantly affected cluster efficiency, whereas other cluster characteristics such as ownership, the number of hospitals within the cluster, the presence of an academic medical center (AMC), or the geographic spread of the cluster within the market area, might not be so important. There is also the question of which cluster members benefit from geographic clustering – the smaller more interdependent hospital members or the larger facilities where service capacities are concentrated. Trinh et al (2010) found that the efficiency and financial benefits associated with sharing clinical services accrues to the hospital that receives the services from a system partner and not to the one that provides the services for system partners. So at this stage, it appears that hierarchical order among hospitals within a cluster is an important factor that may impact hospital efficiency and financial

performance. Additionally, other factors, such as the proximity between same system hospitals, and the differentiation among the hospitals in terms of size and scope of services may indicate where the benefits of clustering will accrue.

In addition to the empirical work that uses the Bazzoli et al. (1999) taxonomy or focuses on local system clusters, there are several other studies that have produced significant findings related to multi-hospital system membership. The results of these studies may be combined with the findings of some of the previously discussed studies and grouped into five categories: market power, lower costs, efficiency, financial performance, and the quality of care.

#### *System Membership and Market Power*

The horizontal integration of independent hospitals into hospital systems concentrates market power, and allows hospitals that once competed with each other to align strategically and use their combined size to negotiate with consumers (Luke, 1992). Increased market power may potentially be harmful to consumers if hospitals use this power to increase prices and limit patient choice by exerting monopolistic power (Reardon & Reardon, 1995; Cueller & Gertler, 2005). Thus research in this area addresses a relevant health policy issue - the tradeoff between cooperation and competition - and raises anti-trust considerations within the hospital industry.

As expected, research analyzing the effect of system membership on market power has produced consistent results showing that system hospitals are able to increase prices more than non-system hospitals (Dranove & Shanley, 1995; Cueller & Gertler, 2005;

Melnick & Keeler, 2007). Depending on the size of the system cluster, hospitals within a same-system cluster were able to increase prices 17-34% more than non-system hospitals (Melnick & Keeler, 2007), and increased prices resulted in higher profits for system hospitals (Dranove & Shanley, 1995). These results are supported by studies of hospital mergers which also show that hospital consolidation results in higher prices (Capps & Dranove, 2004; Krishnan, 2001). In addition to higher prices, system membership also resulted in increased volume of managed care patients (Cueller & Gertler, 2005) and reputation enhancement which facilitated marketing and helped attract more patients (Dranove & Shanley, 1995). More recently the relationship between hospital market power and higher prices has been called into question by a study that found no significant relationship between hospital market concentration (measured with a Herfindahl index) and hospital prices (Moriya et al., 2010). But this study did not directly measure the relationship of system membership to the ability to increase prices, which may be distinct from the relationship of overall concentration to higher prices. Ginsburg (2010) found in a study of eight metropolitan areas that wide variation in hospital prices existed within and across metropolitan areas that could not be fully explained by hospital concentration. Differences in perceived hospital quality, hospital reputation, and system membership are likely reasons for within market price variation not related to hospital concentration (Ginsburg, 2010). Thus there appears to be a clear and consistent positive relationship between market power and system membership as reflected by higher prices which may be linked to increased hospital profits.

### *System Membership and Hospital Costs*

Membership in a hospital system is believed to lower the production costs of medical care because common services may be centralized, excess capacity may be eliminated, and economies of scale may be achieved (Shortell, 1988; Gaynor & Wilson, 1999; Kania, 1993; Luke, 1992). However, research examining the costs of care (usually measured as costs per discharge, costs per day, or costs per admission) has produced mixed results. Further confusing the relationship between system membership and hospital costs is the fact that some researchers refer to differences in hospital costs as differences in efficiency (Cueller & Gertler, 2005; Trinh et al, 2010). To summarize the relationship between system membership and hospital costs, all studies which use some sort of average cost as their dependent variable are included here.

Although not the same as systems, earlier work on hospital mergers showed that hospital consolidation resulted in a 33% decrease in costs per adjusted admission. However, when mergers and systems were examined together, it was clear that only mergers resulted in decreased costs (Dranove & Lindrooth, 2003). This conclusion is consistent with other empirical findings that show no relationship between system membership and hospital costs (Clement et al, 1997; Dranove et al, 1996; Dranove & Shanley, 1995; Madison, 2004; Cueller & Gertler, 2005). It is notable though that with the exception of Madison (2004), who examined the effect of local system partners on AMI treatment, researchers used a simple indicator variable for system membership.

More recent research focusing on the relationship between service provision at the system level and hospital costs has produced significant results. Proenca et al (2005) demonstrated that the sharing of services between system hospitals (i.e. the centralization of services within a given cluster among same system hospitals) is negatively related to hospital costs. Trinh et al (2010) found similar results, noting that hospitals which received services from other system partners had lower costs per day and per discharge. These results support the assertion that the rational organization of services facilitated by system membership may lower hospital costs.

#### *System Membership and Hospital Efficiency*

Although efficiency may be measured in many different ways, this section summarizes empirical studies that use either Data Envelopment Analysis (DEA) or Stochastic Frontier Analysis (SFA) to measure hospital efficiency/inefficiency. DEA is a non-parametric technique used to measure relative productive / technical efficiency, and SFA is a parametric technique that estimates cost inefficiency based on a specified cost function. Regardless of the technique used, there is evidence that system membership does affect efficiency, but the effect is not homogenous for all systems. Thus system type/attributes must be considered when analyzing efficiency.

Using DEA to examine the efficiency of a national sample of hospitals, Ozcan and Luke (1993) found an association between non-system hospitals and low efficiency scores, and showed that system hospitals and contract managed hospitals had higher efficiency scores overall (Ozcan & Luke, 1993). Subsequent work using DEA scores to

measure system efficiency took alternative approaches, including distinguishing systems by using the Bazzoli et al. (1999) taxonomy (Carey, 2003; Rosko et al, 2007), analyzing the provision of clinical services at the system level (Rosko & Proenca, 2005), and focusing on the configuration of local system clusters (Sikka et al, 2009). Results from these studies indicate that sharing services among geographically proximate hierarchical system partners is positively related to hospital efficiency (Rosko & Proenca, 2005; Sikka et al, 2009). However, the results from studies using the Bazzoli et al. (1999) taxonomy do not suggest a clear linear relationship between system centralization and efficiency. Rather, hospitals in systems with centralized physician/insurance services and decentralized system hospitals were more efficient than hospitals in centralized systems, and hospitals in independent systems were the least efficient (Carey, 2003; Rosko et al, 2007). This pattern is neither linear nor curvilinear, and indicates that the Bazzoli et al. (1999) taxonomy of systems may not clearly represent a continuum from centralized to decentralized. Or as previously mentioned may not clearly separate systems that centralize clinical services from systems that centralize other types of logistic and administrative services, or from completely decentralized systems.

#### *System Membership and Financial Performance*

Recent reports on the financial performance of multi-hospital systems show improving operating profits, especially for for-profit systems (Galloro & Piotrowski, 2002). However, operating profits are only one measure of financial performance. Other measures that are commonly used to assess hospital performance include return on assets,



free cash flow, net revenues, and financial ratios that measure liquidity and profitability, all of which may be affected by either increasing revenue and/or decreasing costs.

Empirical studies that seek to relate these financial performance measures to system membership indicate that when system hospitals are compared to non-system hospitals, system hospitals have higher net operating margins (Dranove & Shanley, 1995; Dranove et al, 1996) and higher net revenues (Clement et al, 1997). Further, this performance difference may be related to system hospital's ability to increase prices (Dranove & Shanley, 1995) and is more pronounced for system hospitals that receive services from rather than providing services to system partners (Trinh et al, 2010).

#### *System Membership and Medical Care Quality*

Since the Institute of Medicine published its landmark reports on medical care quality at the turn of the millennium, research on quality indicators has increased dramatically. However, little research has been done that attempts to show that system membership affects medical care quality. It is believed that system membership could result in improved care quality by centralizing specialty services in facilities with sufficient volume to maintain competency, increased use of clinical information systems, and the sharing of expertise and best practices (Cueller & Gertler, 2005; Chukmaitov, 2009) through system-wide quality assurance programs, which is one of the aspects of "systemness" identified by Shortell (1988).

Initially, empirical work by Cueller & Gertler (2005) did not show any significant difference in the quality of care between system and non-system hospitals, as measured

by inpatient mortality, overused procedures, and adverse events. But like other categories of empirical work previously discussed, system effects became evident when researchers focused on system attributes. Emphasizing the importance of local partners, Madison (2004) found that the mortality of AMI patients improved when small rural hospitals joined a system with a proximate large urban partner. However, this effect was not observed for urban hospitals with a local partner in the same MSA. Chukmaitov et al. (2009) also found a system effect on quality when they used the Bazzoli et al. (1999) taxonomy to analyze inpatient mortality for four medical conditions. They found that systems which centralize clinical services provided higher quality care as measured by inpatient mortality, and their findings support the use of the Bazzoli et al. (1999) taxonomy as a continuum along the characteristic of centralization. And although the results of two studies may not be held up as definitive, there appears to be some support to the notion that the centralization of clinical services and the sharing of expertise among system hospitals can improve medical care quality.

*Summary of Research on Multi-Hospital Systems and System Membership*

As membership in multi-hospital systems increased during the 1970s and 1980s, researchers enumerated the potential advantages system membership offered to individual hospitals (Zuckerman, 1979, 1983). But early research on multi-hospital systems found little evidence to indicate that system membership positively affected hospital performance, and lead to the conclusion that the advantages of system membership had yet to be realized (Shortell, 1988). Another possibility was that a

system effect really did exist, but was not apparent in health services research which often used a simple indicator variable for system membership (Rosko et al, 2007). This study addresses the latter concern. To address this issue, researchers have attempted to develop comprehensive taxonomies to differentiate among different types of systems (Alexander & Amburgey, 1987), or focused on specific system attributes which could lead to greater efficiency, economies of scale, and increased market power (Kania, 1993; Luke, 1992).

Conceptual work on multi-hospital system research lead to the creation of the Bazzoli et al. (1999) taxonomy of networks/systems and to a greater focus on local system clusters (Luke, 1992; Cueller & Gertler, 2003), which have become valuable tools for systems research. Empirical studies employing the taxonomy (Bazzoli et al, 2000; Carey, 2003; Rosko et al, 2007; Chukmaitov, 2009) or focusing on structural aspects of local system clusters (Proenca et al, 2005; Sikka et al, 2009; Trinh et al, 2010; Madison, 2004; Rosko & Proenca, 2005) have clearly shown that a relationship between system membership and hospital performance does exist. Research shows a consistent positive relationship between system membership and hospital market power, efficiency, and financial performance (Cueller & Gertler, 2005; Dranove & Shanley, 1995; Melnick & Keeler, 2007; Carey, 2003; Trinh et al, 2010; Ozcan & Luke, 1993; Rosko & Proenca, 2005; Rosko et al, 2007; Sikka et al, 2009; Dranove et al, 1996; Clement et al, 1997), and there is some evidence to suggest that system membership lowers hospital costs and improves inpatient mortality when clinical services are centralized and shared among

local system partners (Proenca et al, 2005; Madison, 2004; Chukmaitov, 2009). The centralization and sharing of clinical services among system hospitals, which is possible for hospitals that are geographically proximate and have a hierarchical order, is critical to realizing improved efficiency and financial performance (Cueller & Gertler, 2005; Carey, 2003; Trinh et al, 2010; Rosko & Proenca, 2005; Rosko et al, 2007; Sikka et al, 2009).

However, the majority of research on multi-hospital system membership (and all of the studies mentioned in the preceding section) either focused exclusively on urban hospitals (Trinh et al, 2010; Dranove & Shanley, 1995; Rosko & Proenca, 2005; Rosko et al, 2007) or pool urban and rural hospitals together (Bazzoli et al, 2000; Carey, 2003; Chukmaitov et al., 2009) and thus fail to allow for potential differences in membership effects between urban and rural hospitals. Research that does not focus on rural hospitals has limited applicability to rural hospital research (Moscovice & Rosenblatt, 1985b), and thus it is important to focus on research that deals specifically with rural hospitals.

#### *Rural Hospitals and Multi-Hospital System Membership*

Examined against the backdrop of the tumultuous 1980s, multi-hospital system affiliation was identified as one of several horizontal and vertical integration strategies that rural hospitals may pursue to improve their chances of survival (Mick et al., 1993) and was seen as a promising strategy for improving rural hospital financial viability (Moscovice & Rosenblatt, 1985b). Distinguished from other multi-institutional arrangements by some form of common ownership, multi-hospital systems generally have more centralized decision making and exert greater control over subordinate

facilities than health networks or consortiums (Alexander et al., 2003), which are other multi-institutional arrangements common in rural areas. Greater centralized control and participation of the system headquarters in decisions regarding member hospital budgets, service offerings, facility plans, and capital outlays (Alexander et al., 2003) led researchers to believe that multi-hospital systems could help rural hospitals overcome problems associated with obtaining critical resources in rural environments typified by declining reimbursement, an aging and increasingly unemployed population, faltering economies, and an inability to attract and retain medical professionals (Berry et al, 1987; Ermann, 1990; Drain et al., 2000; Yarbrough & Powers, 2006). Research into the potential effects of multi-hospital system membership on rural hospitals have generally fallen into three categories: 1) descriptive and/or theoretical papers that describe the presence of multi-hospital systems in rural areas, propose potential relationships between membership and performance, and summarize previous empirical work; 2) empirical studies that analyze system affiliations as their central research question; 3) empirical studies whose primary focus is not system membership, but find significant system effects in their analysis. All three types of studies are discussed below.

#### *Descriptive, Theoretical, and Summary Papers*

The majority of peer reviewed works on rural hospital system affiliation may be classified as either descriptive or theoretical in nature. They include studies that describe the different types and incidences of multi-hospital affiliations in rural communities (Lewis & Parent, 1986; Reardon, 1996), highlight multi-hospital system affiliation as a

strategy employed by rural hospitals to prevent closure and improve financial viability (Moscovice & Rosenblatt, 1985a, 1985b; Smith & Piland, 1990; Seavey & Berry, 1986), summarize previous empirical work on the effects of system membership (Moscovice & Rosenblatt, 1985b; Mick & Morlock, 1990), or offer a prescription for rural system affiliation / partnership (Grim, 1986; Zisner & Hoffman, 1995; Porter & Teisberg, 2006).

The purely descriptive studies chronicle the increasing number of system affiliated rural hospitals and describe the types of affiliations that are most prominent (Lewis & Parent, 1986; Reardon, 1996). Particular interest is paid to the increasing activity of for-profit, investor owned systems in rural areas during the 1980s (Lewis & Parent, 1986) and concern that investor owned systems will eliminate excess capacity in or close rural hospitals which they acquire (Reardon, 1996). However, the majority of system owned rural hospitals are non-profit, and perhaps the more relevant assertions from these studies are that systems are more likely to emphasize cost containment strategies, system membership may help rural hospitals attract and retain medical and administrative personnel, and system membership provides greater access to knowledge and resources that help reduce costs and increase profits (Reardon, 1996; Lewis & Parent, 1986).

These assertions are more closely related to the hypotheses found in empirical research and are mentioned as some of the reasons that rural hospitals would pursue system affiliation as a strategic response to a challenging environment (Moscovice & Rosenblatt, 1985a, 1985b; Seavey & Berry, 1986; Smith & Piland, 1990). Viewed as a trade of autonomy for access to scarce resources (Moscovice & Rosenblatt, 1985b,

Zuckerman, 1983), several authors have examined rural hospital system affiliation through the theoretical lens of resource dependence (Mick et al, 1993; Berry et al., 1987; Alexander & Morrissey, 1989). Resource dependence theory postulates that when organizations experience great uncertainty associated with obtaining critical resources, they will respond by taking action to decrease uncertainty which may include altering their relationships with other organizations (Pfeffer & Salancik, 1978). All else being equal, organizations would prefer to remain autonomous and obtain necessary resources without becoming overly dependent on other organizations, but when they lack the organizational power to obtain resources for themselves, they will trade autonomy for access to scarce resources. Hesitant at first to give up local autonomy (Moscovice & Rosenblatt, 1985b; Seavey & Berry, 1986) many rural hospitals joined local networks or voluntary consortia (Broyles et al., 1998; Mick et al, 1993) or opted for less constraining forms of system affiliation, such as contract management (Lewis & Parent, 1986; Alexander & Morrissey, 1989). But as environmental uncertainty persists rural hospitals are increasingly willing to trade their autonomy for access to scarce resources by joining a system. The potential advantages of doing so are improved financial performance (Smith & Piland, 1990), the realization of economies of scale, increased productivity, better staffing, and improved access to capital financing (Moscovice & Rosenblatt, 1985b).

But summaries of previous empirical research conclude that these potential advantages have not been realized by rural hospitals (Moscovice & Rosenblatt, 1985b;

Mick & Morlock, 1990) or throughout the hospital industry in general (Shortell, 1988). Closer inspection of these summaries reveals that they actually reference only one empirical study specifically about rural hospital system membership [Mick and Morlock (1990) reference the Berry et al. (1987) study]. The other empirical works cited in these summaries are studies with samples containing only urban hospitals or a mix of urban and rural hospitals. Thus there appears to be a dearth of evidence supporting or rejecting the proposed advantages of rural hospital system membership.

Additionally, the empirical work on rural system membership does not appear to account for the recommendations of what may be called prescriptive writings on rural hospital system affiliation and health system organization. These writings specifically mention the potential benefits of rural hospitals partnering with nearby urban hospitals / hospital systems (Grim, 1986; Zisner & Hoffman, 1995; Porter & Teisberg, 2006). These authors assert that the most beneficial system relationships for rural hospitals are those where rural hospitals that are in close proximity to an urban area join or create a partnership with a hospital / system in that urban area. Such partnerships could benefit rural hospitals and would include visiting specialty clinics, capital investments by the urban partner in the rural hospital physical plant and clinical/information technology, and collective managed care and HMO bargaining activities (Zisner & Hoffman, 1995). Rural hospitals would not operate as isolated, stand-alone organizations, but would become part of local / regional systems where the system could rationalize and centralize hospital services, removing the bias toward local care which has lead independent rural



hospitals to attempt to meet all of the needs of the local community (Porter & Teisburg, 2006). Such arrangements would be beneficial for both the rural and urban facilities, and could result in greater financial stability, improved quality of care, and effective use of health care resources for rural hospitals (Grim, 1986). These types of rural-urban partnerships have not been explicitly considered in the body of empirical work on rural system membership, which is fairly small.

*Empirical Studies on the Effects of System Membership / Affiliation*

Focusing only on those papers that deal specifically with rural hospitals reduces the number of empirical studies on the effects of system membership to five: Berry et al, 1987; Halpern et al, 1992; Mick et al., 1993 and 1994; Trinh & Begun, 1999. Using both pre-PPS (Berry et al., 1987) and post-PPS data (Halpern et al., 1992; Mick et al., 1993 and 1994; Trinh & Begun, 1999) these five studies examine the affect of system membership on hospital performance and survival (Berry et al., 1987; Halpern et al., 1992), system membership as one of several organizational strategies that may impact hospital financial performance (Mick et al., 1993 and 1994), and system membership as an organizational pressure that influences hospitals' choice of cost containment or revenue enhancement strategies (Trinh & Begun, 1999).

In 1987, Berry, Tucker, and Seavey published a study that examined the effects of system ownership and/or management on rural hospital performance. Berry and Seavey had previously published a descriptive study on the strategic responses of rural hospitals in New Hampshire and Kentucky to the challenges they faced in the 1980s. In that study

they identified multi-hospital system affiliation as a strategy that could improve the viability of rural hospitals, and the next logical step was to explore the validity of that observation through empirical research. Their 1987 paper used a national sample of rural hospitals that they categorized as either being independent self-managed hospitals, independent system-managed hospitals, or system owned and managed hospitals. Using resource dependence theory as the theoretical framework, Berry et al. proposed that hospital performance was determined by organizational characteristics, environmental characteristics, and the adaptive strategy chosen by the hospital. Ownership by a multi-hospital system was identified as an adaptive strategy that was distinct from being contract managed or remaining independent. The primary organizational characteristic explored was size and several environmental variables such as per capita income, physicians per 100,000 persons, the unemployment rate, and the percent of persons over 65 were used to judge the degree of support the local environment provided the hospital. The primary performance measure was inpatient occupancy, and secondary performance measures included JCAHO accreditation, average costs per admission and per patient day, and services offered by the hospital.

The primary findings of the study were that hospitals in more supportive environments performed better than those in less supportive environments, larger hospitals (over 50 beds) performed better than smaller hospitals (under 50 beds), and that there was no clear relationship between system ownership and hospital performance. This conclusion about the effect of system ownership was largely based on the primary

performance measure of inpatient occupancy, but there were some significant differences in the secondary performance measures. System owned hospitals were more likely to be accredited by JCAHO, had a shorter average length of stay (ALOS), had lower bed staffing levels, and had higher costs per patient day but lower costs per admission than independent self-managed and system-managed hospitals. Further, the authors also found that system owned hospitals were located in more supportive communities characterized by faster growing populations and fewer beds per 1,000 people.

Although the general conclusion by Berry et al. (1987) is that no system related performance difference exists, it may be inferred from their results that system owned facilities are more effective at controlling costs (fewer FTEs per bed, lower ALOS, and lower cost per admission) than independent rural hospitals, and system affiliation may help to enhance the quality reputation of rural hospitals (increased JCAHO accreditation), which has traditionally been perceived as lower than that of urban hospitals (Reardon, 1996; Yarbrough & Powers, 2006; Li et al., 2007). These findings support the idea that system membership could affect the efficiency and financial performance of rural hospitals. Fewer FTEs per bed could directly affect efficiency measures, and a greater emphasis on cost control could affect a hospital's bottom line. Additionally, an improved reputation for quality often signaled by JCAHO accreditation could lead to increased patient volume by reducing the "outshopping" behavior of local residents.

Realizing that implementation of the PPS disproportionately affected rural hospitals and threatened their financial viability; Halpern et al (1992) used post-PPS data to

analyze the effect of multi-hospital system membership on rural hospital survival. They proposed that affiliation with a multi-hospital system could be interpreted as a survival strategy employed by struggling rural hospitals. Seeking to address methodological issues which include failure to account for system type and the absence of environmental / organizational conditions that would favor system affiliation, the study pays particular attention to the ownership of the system and conducts analysis to determine if hospital characteristics moderate system membership effects.

The results of the study are stratified by system ownership type, separating the effects of for-profit systems from those of non-profit systems. Using a Cox proportional hazards model to estimate the likelihood of hospital closure, Halpern et al. (1992) found that rural hospitals that join investor-owned systems are more likely to close than hospitals that are not affiliated with a system. While this finding runs counter to the idea that system affiliation provides access to scarce resources for distressed hospitals, the researchers note that this may be attributable to the fact that investor-owned systems are more aggressive at reducing excess hospital capacity and thus improving the operating environment for all of the remaining hospitals. Additionally, the authors report moderating effects for hospital size and prior performance, which show that large size increases the likelihood that hospitals in for-profit systems will close and poor prior financial performance decreases the likelihood that hospitals in for-profit systems will close (Halpern et al, 1992). Making the assumption that large rural hospitals are more likely to have excess capacity, these results somewhat support the author's supposition

that for-profit systems are more active at reducing excess capacity, and also indicate that systems really do provide critical resources to hospitals that are in distress.

Another important finding from this study is that there is a selection effect for for-profit hospital systems. Realizing that affiliation with a multi-hospital system is a two-way decision requiring the consent of both the rural hospital and the system, Halpern et al (1992) analyze their data to determine if there is a selection effect for hospital systems. Although not specified as a directional hypothesis, the authors posit that the hospitals that join systems may be systematically different from those that do not join systems. They also recognize that this may be a function of the choice made by the rural hospitals (i.e., which hospitals choose to surrender their autonomy in exchange for membership) or the multi-hospital system (i.e., which hospitals do the systems accept into their system). Once again splitting the hospital systems by ownership type, the results of the analysis reveal that there is no selection effect for non-profit systems, but poorer performing hospitals are more likely to join for-profit systems (Halpern et al, 1992). However, there are no data to indicate if this is a function of distressed hospitals choosing for-profit systems that can supply resources or for-profit systems choosing poor performing hospitals where they can improve performance quickly.

Mick et al. (1993 and 1994) examined multiple horizontal and vertical integration strategies of rural hospitals, which included multi-hospitals system membership. Using a resource dependence framework similar to that of Berry et al (1987), Mick and colleagues first related various rural hospital strategies to the environmental

characteristics of munificence, complexity, and dynamism (Mick et al., 1993) and then analyzed the effect of the chosen strategy or strategies on hospital financial performance, which was measured by total margin and current ratio (Mick et al., 1994). Multihospital system ownership was one of four horizontal integration strategies (the other three were group purchasing, voluntary consortia, and merger) hypothesized to be negatively related to environmental munificence, positively related to environmental dynamism, and not related to the complexity of the environment. The authors note that horizontal strategies may offer hospitals located in areas with high turbulence (complexity) and scarce resources (low munificence) a chance to achieve economies of scale, reduce redundant services, and access greater managerial talent and capital investment (Mick et al., 1993). However, the results of the first paper did not support the directional hypotheses relating horizontal integration strategies to environmental munificence and complexity. Similarly the second paper (Mick et al., 1994), which hypothesized that rural hospital strategic management activity would positively influence financial performance, did not reveal any widespread nor consistent relationship between hospital strategy and financial performance. Further, the only significant coefficients related to multi-hospital system affiliation indicated a negative short-term relationship between hospital current ratio and the strategy of system membership. Thus the combined results of the two Mick et al. studies do little to support the assertion that system membership effects hospital financial performance.

A somewhat different type of study is the paper by Trinh & Begun (1999), which examines the effect of organizational and environmental pressures on rural hospital strategy. Multi-hospital system membership is identified as one of two organizational pressures (the other is non-government control) that potentially influence a hospital's choice of either cost containment or revenue enhancement strategies. The environmental pressures that are measured in the study are the munificence and competition of the local market and the Medicare reimbursement policy for the state in which the hospital operates. The authors hypothesize that system membership and more restrictive Medicare reimbursement will be positively associated with cost containment strategies while munificence, competition, and government control are positively related to revenue enhancement strategies. The results from the study support the hypothesized relationships, and also indicate that organizational pressures like system membership have a greater influence over rural hospitals' choice of strategy than environmental pressures. Trinh and Begun elaborate on this point by speculating that the actual relationship between organizational and environmental pressures is more complicated than portrayed in their model. Environmental pressures may first influence organizational characteristics which then influence strategy (Trinh & Begun, 1999). These findings support the work of Berry et al (1987) who also found a link between system membership and cost containment, and suggest that environmental characteristics and organizational characteristics must be considered simultaneously to assess the effects of organizational differences like system membership on performance.

Considered together, these five studies offer some support for a relationship between rural hospital system membership and hospital performance. Even though the results of Mick et al. (1993 & 1994) lead to the conclusion that no consistent relationship exists, the other three papers indicate that system membership is associated with a greater emphasis on cost containment and the reduction of excess capacity (Berry et al., 1987; Trinh & Begun, 1999; Halpern et al., 1992), and Berry et al. (1987) found bed staffing and accreditation effects that could contribute to a hospital's efficiency and/or financial performance. Additionally, there are more recent studies on rural referral centers (RRCs) and rural hospital health information technology (HIT), which contain significant findings related to system membership. These findings add to the evidence that supports a link between system membership and hospital performance.

#### *Other Empirical Studies on Rural Hospitals with Relevant Findings*

Although not specifically focused on the effects of system membership, recent papers analyzing the financial performance of RRCs (McCue, 2007) and the adoption of HIT by rural hospitals (Menachemi et al., 2005) offer support for the assertion that system membership positively affects rural hospital efficiency and financial performance. Analysis of RRCs indicates that system owned hospitals had lower costs per adjusted discharge and lower salary expenses (measured as a percentage of operating expenses) than non-system hospitals. Because RRCs are a special type of rural hospital, these results may not be generalized to the population of rural hospitals, but offer general



support to the conclusion that system membership is related to a greater emphasis on cost containment (Berry et al., 1987; Trinh & Begun, 1999).

Research on HIT adoption in rural hospitals reveals another way that system membership may positively affect rural hospital economic performance. Citing a lack of financial resources and access to capital for HIT investment (Bahensky et al., 2008), rural hospitals have lagged behind their urban counterparts in the use of IT applications and clinical technological devices (Culler et al., 2006). However, system owned rural hospitals were significantly more likely to have information systems than their stand-alone counterparts, and were less likely to cite financial barriers as a reason for not adopting HIT (Menachemi et al., 2005). This finding was supported by Li et al. (2008) who noted that system membership was positively associated with electronic medical record adoption in small hospitals, which are disproportionately rural. Greater use of HIT in system owned rural hospitals indicates that system ownership does result in greater access to capital resources / financing, which is often mentioned as a potential advantage of system membership (Moscovice & Rosenblatt, 1985b; Mick & Morlock, 1990; Mick et al., 1993). Further, increased use of HIT has been shown to improve physician and nurse time utilization, increase provider productivity and lower staffing requirements (Kaushal, 2006; Mekhjian, 2002; Evans, 2006; Hillestad, 2005). Thus system membership may positively affect hospital efficiency through the mechanism of greater HIT utilization.

## Summary and Critique of Systems Research

Research on rural hospital system membership includes descriptive and theoretical works that chronicle the growing number of system owned rural hospitals (Reardon, 1996; Lewis & Parent, 1986) and describe the potential advantages that system membership may provide (Moscovice & Rosenblatt, 1985b; Alexander & Amburgey, 1987; Zuckerman, 1983). Summaries of existing research generally conclude that these advantages have not been realized (Mick & Morlock, 1990), but close examination of the few empirical studies that do exist on rural hospital system membership provide some support for the hypothesis that system ownership may positively affect rural hospital economic performance through emphasis on cost containment, increased accreditation, and more efficient staffing (Berry et al., 1987; Trinh & Begun, 1999). Additionally, more recent studies on the financial performance of RRCs and HIT adoption by rural hospitals support the cost containment and staffing findings of the previous studies (McCue, 2007) and indicate that system ownership does provide rural hospitals greater access to investment capital.

However, these results are based on only a few empirical studies, and the ones that focus specifically on system membership are more than 10 years old (Berry et al., 1987; Halpern et al., 1992; Mick et al., 1993 & 1994; Trinh & Begun, 1999). A review of The Journal of Rural Health, the primary journal for rural health research, reveals that there have not been any empirical articles specifically about rural hospital system membership in 15 years. Two potential explanations for this are that early conclusions that system

ownership did not affect performance discouraged other research, or that researchers interested in structural changes to rural hospitals focused on conversion to CAH status, which is a more recent and easily identifiable change in the rural hospital population. Regardless of the reason, research on rural hospital system membership is dated and may not adequately represent the current reality.

Additionally, the research that does exist does not reflect recent conceptual advances in systems research that account for structural and functional characteristics such as the centralization of common support services, the geographic proximity of system partners, the presence or absence of hierarchical order among member hospitals, and the provision of clinical services at the system level. Use of the Bazzoli et al., (1999) taxonomy and a focus on local hospital clusters and system partners has produced more significant results than previous work that used an indicator variable for system membership. However, it may not be appropriate to use the Bazzoli et al. taxonomy to study rural hospitals. The taxonomy was developed using a mixed sample of urban and rural hospitals, in which the majority of system hospitals were in urban areas (Bazzoli et al., 1999). Therefore the taxonomy may be overly influenced by the characteristics of urban hospitals / systems which would limit its applicability to the rural environment. Further, empirical results using the taxonomy do not clearly indicate if it represents a continuum of systems ordered along the construct of centralization (Carey, 2003; Rosko et al., 2007; Chukmaitov, 2009), making it difficult to form directional hypotheses using the taxonomy. A better approach may be to apply the thinking of researchers that analyze

local system clusters (Cueller & Gertler, 2003; Kania, 1993; Luke, 1992), by focusing on the geographic proximity and hierarchical order of system partners that enable the centralization and integration of clinical and support services.

Previous research on rural hospital system membership has also been criticized for not considering the significance of economic, structural, and environmental conditions that may determine when system affiliation is most appropriate (Halpern et al., 1992). While it is common to use organizational characteristics in hospital research and the use of resource dependence theory has led to the inclusion of environmental factors (Berry et al., 1987; Mick et al., 1993, 1994) in systems research, these variables have primarily been employed as control variables, used to divide hospitals or systems into categories, or combined with system membership to create interaction terms (Halpern et al., 1992). Methodologically this allows researchers to better isolate the main effect associated with system membership (control variables), stratify the main effect across the levels of a given characteristic (categorization), or show that a main effect is moderated by a given characteristic (interaction term), but does not show when system membership would be most appropriate / beneficial. In order to predict and then show when system membership is most appropriate, a contingency approach that matches different combinations of environmental and organizational characteristics to system membership should be used (Smith & Piland, 1990). None of the currently published studies on rural hospital system membership use such an approach.

Finally, the creation of the Flex program and the conversion of rural hospitals to CAH status is a major structural change in the rural hospital population that has not been considered by the existing research on rural hospital system membership. Most research on rural hospital system membership was conducted prior to 1999, so the phenomenon of CAH conversion was not addressed. Further, more recent studies of multi-hospital systems tend to focus on urban hospitals where CAH status is not a significant issue. However, in the rural hospital population CAH conversion is a significant issue that affects the structure and financial performance of rural hospitals, and must be considered in any study of rural hospital performance.

#### CAH Status and Multi-Hospital System Membership

Studies on the effect of CAH conversion have shown that conversion significantly effects financial performance (Li et al., 2009a; Younis, 2006), the quality/safety of care (Li et al, 2007), cost inefficiency (Rosko & Mutter, 2010), and production efficiency (Harrison et al., 2009). Additionally, the presence of a CAH in a rural community has been shown to effect patient flows and transfer rates between rural and urban areas (Basu & Mobley, 2010; Wakefield et al, 2006). Thus CAH conversion has been shown to affect the same dependent variables (efficiency and financial performance) that are used in this study, and may significantly alter the interaction between rural and urban system partners.

Looking first at the studies on financial performance, researchers have shown that conversion to CAH status is good for a hospital's bottom line. Conversion to CAH status

is associated with increased revenues, expenses, and profit margins (Li et al., 2009a), and hospitals converting to CAH status increased their profit margins more than any other type of hospital in the BBA implementation period (Younis, 2006). This makes intuitive sense since a large percentage of CAH reimbursement is guaranteed to be at 101% of costs. However, it is not completely clear how this could alter the effects of system membership, which has been associated with increased profit margins (Trinh et al, 2010; Dranove et al, 1996; Dranove & Shanley, 1995). System membership has been associated with increased market power, which allows system hospitals to increase prices more than non-system hospitals (Cueller & Gertler, 2005; Melnick & Keeler, 2007). But CAHs have a much larger percentage of Medicare patients than non-CAH rural hospitals (Rosko & Mutter, 2010), and Medicare reimbursement is fixed at 101% of costs. CAHs have a smaller percentage of private pay patients for which they can negotiate payment rates, and thus the positive financial contribution from price increases associated with system membership may be smaller for CAHs than for other rural hospitals.

CAH status has also been shown to significantly affect hospital efficiency. Harrison et al. (2009) used Data Envelopment Analysis (DEA) to examine the change in CAH efficiency over a two year period (2005-2006). Using a windows analysis, the researchers determined that CAH efficiency increased from 60% to 66% over the two year period. However, they did not have a non-CAH comparison group in their study, so it cannot be determined if this increase in production efficiency is greater or less than the change in efficiency of other rural hospitals or all hospitals in general. A more recent

study by Rosko & Mutter (2010) did contain a comparison group of rural PPS hospitals, and compared the cost inefficiency of CAH hospitals to rural PPS hospitals over a multi-year period. Using Stochastic Frontier Analysis (SFA), they found greater cost inefficiency in critical access hospitals compared to PPS rural hospitals in a 34 state sample. They offer this as evidence that cost-based reimbursement under the Flex program essentially removes the efficiency incentives inherent in the PPS program and leads to greater cost inefficiency (Rosko & Mutter, 2010). Thus, conversion to CAH status leads to greater inefficiency while system membership has been shown to lead to greater efficiency (Ozcan & Luke, 1993; Trinh et al., 2010; Rosko & Proenca, 2005; Rosko et al, 2007). However, the mechanisms for these two effects are not completely clear. Studies on rural hospital system membership indicate that system membership leads to a greater emphasis on cost containment strategies, which is reflected in lower costs per admission/discharge and leaner staffs (Trinh & Begun, 1999; Berry et al., 1987), but studies on CAH efficiency did not clearly identify a mechanism that made CAHs more inefficient than non-CAH rural hospitals. Rosko & Mutter (2010) simply observe that inefficiency is positively correlated with the length of time that a hospital has held CAH status. This leads them to conclude that cost based reimbursement removes the incentive to control costs. But what is unclear is which logic will dominate the behavior of a rural hospital that is both a member of a system and a CAH. If systems really do stress efficiency and cost containment, then they could prevent the adverse effect of cost based reimbursement on efficiency postulated by Rosko & Mutter (2010).

Perhaps of more importance are the ways in which CAH status can potentially affect the transfer behavior of rural hospitals and the flow of patients between rural and urban areas. Prescriptive writings on rural hospital system membership have emphasized the importance of connecting rural hospitals with urban partners and noted the ways in which such partnerships could benefit both hospitals (Grim, 1986; Zismer & Hoffman, 1995; Porter & Teisberg, 2006). If the rural hospital were a CAH, this relationship could be even more beneficial.

In a study of rural hospital ICUs, Wakefield et al. (2006) found that CAHs had greater transfer rates of ICU and non-ICU patients than non-CAHs. Thinking of a patient transfer as a transaction between two organizations, Transaction Cost Economics theory indicates that hierarchies (i.e. common ownership of the two organizations conducting the transaction) are the preferred organizational form as transaction frequency increases (Williamson, 1975). Assuming that most transfers would occur between hospitals of different size (i.e., a smaller rural hospital would transfer to a larger hospital with more services and inpatient capacity), it is logical to conclude that the increased transfer rates of CAHs would mean that they gain the greatest benefit from a hierarchical relationship with a proximate larger hospital, which would most likely be located in an urban area. Thus CAH status may enhance the benefits of rural-urban partnerships.

There is also evidence that conversion to CAH status affects the bypass behavior reported in many rural areas. Sometimes referred to as “outshopping”, the practice of rural residents bypassing their local hospital reduces rural hospital patient volume and



hurts their financial viability (Baldwin et al., 2008; Radcliff et al.; 2003; Saunders et al., 2009). System membership has been shown to increase a hospital's ability to market itself and provides reputation benefits (Dranove et al., 1996; Dranove & Shanley, 1995), which may help rural hospitals capture more of their local patients. This effect may be magnified by CAH status. In a 2010 study, Basu & Mobley found that the presence of a CAH reduced the bypass behavior of rural residents in California and New York. Together, these findings may indicate an additive effect of system membership and CAH status on bypass behavior. A significant reduction in bypass behavior could increase the volume of patients treated at rural hospitals allowing them to become more efficient and profitable.

#### Literature Synthesis and Gap Addressed by this Study

The formation of multi-hospital systems represents one of the largest structural changes to the hospital industry over the past 50 years. As the number of hospitals affiliated with systems increased, system advocates and health services researchers asserted that health systems could instill some order to the patchwork of independent hospitals and providers that constituted the health care industry in the United States. Drawing on earlier writings that outlined the beneficial characteristics of centrally planned systems, it was believed that multi-hospital systems could rationally organize the provision of services and improve patient care by centralizing and integrating medical services among the hospitals in a given region. However, empirical work found little support to indicate that systems actually accomplished this.

Still, when the PPS was implemented in the mid 1980s, disproportionately affecting the reimbursement and financial viability of rural hospitals, system membership was postulated to be a survival strategy for struggling rural hospitals. By providing greater access to capital resources, leverage in bargaining with managed care organizations, and assistance in securing necessary clinical and administrative staff, multi-hospital systems could improve the performance and financial viability of rural hospitals. Yet, once again there is not a lot of empirical research to support these claims. The few existing studies that do examine the effect of system membership on rural hospitals indicate that system membership results in increased emphasis on cost control, lower average costs per discharge, and lower staff expenses. Additionally, more recent studies on RRCs and the use of HIT in rural hospitals offer some support for the hypotheses that system membership can improve financial viability and access to technology. But the majority of these studies are more than 10 years old and may not accurately reflect the current reality of the rural hospital population.

More recently hospital systems research has primarily focused on urban hospitals or used national samples that mix urban and rural hospitals together. While the results of these studies have limited applicability to the rural environment, it is important to note that significant results have been obtained largely due to conceptual / methodological advances that have not been applied to studies of rural system membership. The creation of an over-arching taxonomy of systems and a focus on the configuration of local system clusters have allowed researchers to find significant relationships between system

membership and market power, efficiency, financial performance, and inpatient mortality. But these tools have not been applied to the population of rural hospitals, and it may not be appropriate to apply a taxonomy developed using a sample of urban and rural hospitals to a study of purely rural hospitals. A preferred technique would be to use the logic of local system clusters, which stresses geographic proximity and hierarchical order among system partners, to the study of rural hospital system membership. A focus on such system structural characteristics would facilitate the use of a contingency approach which links environmental and organization/system structural characteristics together to determine when system membership may be most beneficial to rural hospitals.

Additionally, due to the age of the existing studies of rural hospital system membership, the effects of conversion to CAH status have not been considered in systems research. Conversion to CAH status is a significant event that results in structural and behavioral changes to rural hospitals, and may interact with the effect of system membership on hospital financial and efficiency measures. Further, CAH conversion affects rural hospital patient transfer rates and rural patient bypass behavior, potentially enhancing the importance of urban-rural system partnerships advocated by several writers.

Viewed as a whole, there is a clear gap in the body of research on multi-hospital system membership. Research on the effects of rural hospital system membership is dated, has not benefited from recent advances in the larger body of systems research, and the important characteristic of CAH status has not been explicitly considered. This study

seeks to address this gap in the literature by using a contingency theory framework which considers the geographic proximity and hierarchical order of system partners as well as CAH status, to focus explicitly on the effects of system membership on rural hospitals.

## CHAPTER 3 – THEORETICAL FRAMEWORK

The conceptual model for this study is based on contingency theory, and models rural hospital performance as an outcome that is significantly affected by the fit between the hospital environment and the structure of the system to which it belongs. This chapter not only presents the conceptual model for the study, but also discusses the theory on which it is based and the hypotheses which are derived from the model. The first section of the chapter provides a brief overview of contingency theory and discusses why it was chosen over other theories for this study. Next, the contingent relationships which pair environmental/hospital contingencies with multi-hospital system structural characteristics are presented and discussed. Then these contingent relationships are aggregated and the complete conceptual model is presented. Finally, the hypotheses that flow out of the conceptual model are stated.

### An Overview of Contingency Theory

Contingency theory was developed in the 1960s to study questions related to organizational performance (Woodward, 1965; Lawrence & Lorsch, 1967; Thompson, 1967). Sometimes referred to as structural contingency theory, it contains the basic paradigm that organizational performance depends on an organization's ability to fit its structure to contingencies that reflect the situation of the organization (Donaldson, 2001). Underlying this paradigm are three basic assumptions: 1) there is no one best way to

organize for every situation; 2) different ways of organizing are not equally effective for a given situation; and 3) for a given situation, the best way to organize depends on the dominant environmental characteristic (Thompson, 1967). Thus contingency theory is fundamentally different from universalistic theories that associate higher organizational performance to the maximum level of a given environmental or structural variable (Donaldson, 2001). Contingency theory argues that organizational performance depends upon the degree of fit between environment and organization, which implies that organizations with different structures may perform equally as well in different situations. This makes the identification of contingent relationships that pair environmental contingencies with organization characteristics central to contingency theory research.

One formulation of the theory, which grew out of industrial organization economics, uses the constructs of complexity, uncertainty, and interdependence to describe the work an organization performs and the constructs of differentiation, centralization, and coordination to describe organizational structure (Scott & Davis, 2007). These constructs are paired together in contingent relationships (complexity with differentiation, uncertainty with centralization, and interdependence with coordination) and performance depends on the degree of “fit” between the two sets of constructs. The basic directional propositions are that greater complexity of inputs requires greater organizational differentiation, greater uncertainty of inputs requires less centralized decision making, and greater interdependence of work processes requires more coordination mechanisms

to achieve integration of work effort. However, not all authors focus on these three contingent relationships.

Donaldson (1995, 2001) asserts that the most prominent contingencies that must be considered by an organization are environmental stability, organizational size, and strategy. Once again, these three contingencies are paired with the organizational characteristics of mechanistic structure, bureaucratic structure, and divisional structure, to form contingent relationships. The directional propositions associated with these contingencies are that environmental stability (often referred to as environmental uncertainty) is negatively related to a mechanistic structure (Burns & Stalker, 1961), organizational size is positively related to organizational bureaucracy (Childs, 1975), and strategic diversification is positively related to a divisional structure (as opposed to a functional structure) (Chandler, 1962). Although none of these propositions directly contradicts the ones in the preceding paragraph, it is easy to see why the lack of consistency among contingency theorists in terms of explicitly stated directional propositions is one of the major criticisms of the theory (Schoonhoven, 1981). However, what is more important than enumerating the various propositions that have been posited by different authors is identifying the core ideas that underlie all correct statements of the theory.

Summarized by Donaldson (2001), contingency theory contains three core ideas. First, there is a relationship between contingency and structure. Regardless of the contingency or contingencies identified in a given work, there is a theoretical relationship

between a given contingency and its corresponding structural characteristic. Second, contingency change causes organizational structural change. This is an important core idea that relates to the notion of causality, and implies that contingency change occurs before organizational structural change. Finally, the third core idea is that fit affects performance. Performance is not determined by the level of one or more environmental or organizational variables, but by how well the level of the organizational variable fits the environmental contingency. Thus the calculation of the degree of fit or congruence between organizational structure and environmental contingency (or contingencies) is central to empirical work using contingency theory.

Casting aside specific contingent relationships and focusing on these three core ideas results in a much more general statement of the theory that says that organizational performance depends on the degree of fit or congruence between the dominant environmental characteristic(s) and the structure of the organization (Donaldson, 1995; Scott & Davis, 2007). The specification of the contingent relationships and the definition of performance are left up to the researcher, and depend on the organization being studied. This allows researchers to tailor the theory to a specific research problem or question, and is one of the advantages of using contingency theory as the theoretical framework for this study. Additional advantages of using contingency theory rather than other prominent organization theories such as resource dependence, population ecology, or transaction cost economics, are its focus on performance, its depiction of organizational leaders as rational actors, and the central role of the concept of “fit”.



### *Focus on Performance*

Searching through the organizational theory toolbox, contingency theory is the only theory explicitly developed to explain variations in organizational performance.

Although other major theories have been used to study organizational performance, a quick look at the origins of these theories reveals that they were developed to address fundamental questions other than performance. Transaction cost economics seeks to explain why organizations exist instead of just markets (Williamson, 1975, 1981).

Institutional theory focuses on why organizations are the same (DiMaggio and Powell, 1983). Population ecology examines the role of inertia and environmental selection to explain the birth and death rates within a population of organizations (Hannan and

Freeman, 1977). Resource dependence focuses on how organizations manage interdependent relationships to secure necessary resources (Pfeffer and Salancik, 1978).

While all of these theories are open theories that consider the interaction of the organization and its environment, none of them were developed to explain why some organizations perform better than others.

Contingency theory is different. It was specifically developed with organizational performance in mind (Donaldson, 2001). Faced with the reality that organizational performance varies within a given industry, researchers and theorists were left with one of two choices: 1) to conclude that performance differences were completely random; or 2) that variations in performance are not random and can be explained. Considering that the goal of organization theory is to reduce the complexity of the empirical world through

explanation and prediction (Bacharach, 1989), theorists clearly chose the second option and developed contingency theory, which has been the dominant organizational theory for studying organizational design and performance (Tosi and Slocum, 1984; Drazin and Van de Ven, 1985; Scott, 1990). So in a study of rural hospital performance, it is most appropriate to use the one theory that was developed to study organizational performance rather than adapting another organization theory to this purpose.

### *Room for Agency*

Contingency theory acknowledges the role of organizational leaders and allows room for the idea that their actions may significantly have an impact on organizational performance. As opposed to other major organization theories, which minimize the importance of organizational leaders / actors (population ecology and institutional theory) or attribute their actions to goals other than increasing organizational performance/ efficiency (resource dependence), contingency theory portrays organizational leaders as rational actors who modify the structure of the organization to achieve better performance. It is important to note that this does not mean that organizational leaders are prescient or omniscient. Indeed they are “boundedly rational” (March and Simon, 1993) but to the extent that they understand the environment and can identify ways to adapt organizational structure, they will choose the best alternative in order to improve performance.

This notion of rational actors is contained in the “structural adaptation to regain fit” (SARFIT) model proposed by Donaldson (1995 and 2001). The SARFIT model posits

that organizations actively seek to maintain fit with the environment by adapting organizational structure. When the degree of fit is high, organizational performance is high and the organizational structure is stable. As the environment changes, fit worsens, organizational performance declines, and, once performance has declined a noticeable amount, organizational leaders will take action to change the organization and regain fit. This is a cyclic process that is repeated throughout the life of an organization.

This rational view of organizational leaders who take action in response to poor organizational performance seems to accurately represent the reality of rural hospitals, where the pursuit of system membership is seen as a strategic response to environmental challenges that negatively affected rural hospital performance and threatened their survival (Yarbrough & Powers, 2006; Alexander & Amburgey, 1987; Mick et al, 1993; Reardon, 1996). However, it is important to note that joining a multi-hospital system is not simply the decision of the rural hospital leadership. In order to form a union, both the leaders of the system and the leaders of the rural hospital have to be involved, thus it is most likely the case that not all rural hospitals that want to be part of a system achieve this goal. Regardless, a rational view of hospital leaders most accurately represents the reality of their actions, even if those actions are unproductive.

#### *The Concept of Fit*

The concept of fit, which is central to contingency theory, does not assume a universal positive or negative effect for system membership. Previous studies that have concluded that no consistent or significant relationship between system membership and

rural hospital performance exists (Mick et al, 1994; Berry et al, 1987), have acknowledged heterogeneity among rural hospitals and the communities in which they are located, but have still hypothesized a uniform effect across all rural hospitals. An alternative approach for studying rural hospital system membership is to consider economic, structural, and environmental conditions that may determine when system affiliation is most appropriate (Halpern et al, 1992). As suggested by Smith & Piland (1990), this may be accomplished by using a contingency theory framework that matches different combinations of environmental and organizational characteristics and measures the fit or congruence between them. Then hospital performance is regressed upon the measurement of fit rather than on an indicator variable representing system membership.

This small, but important, change in analytic methods is driven by the use of contingency theory for the study's theoretical framework, and allows the performance effect of system membership to vary across rural hospitals based on market area environmental characteristics and hospital / system structural differences. Relating the measurement of fit to hospital performance also allows for the possibility that similar system structures may affect hospital performance differently in different situations, or that different system structures may affect hospital performance similarly in different situations. Thus the measurement of a fit term will not only identify when an organization's structure fits its environment, but will also reveal when a misfit is present. And, if system membership is not universally beneficial as Halpern et al. (1992) suggest,

then researchers using contingency theory are more likely to detect this by measuring fit and misfit.

### *Identification of Contingent Relationships*

As previously mentioned, another advantage of contingency theory is its ability to be tailored to a specific research question or problem. The primary way that this is done is through the identification of the contingent relationships that may have the greatest effect on organizational performance. Each contingent relationship contains two parts: the contingency and the corresponding organizational structure. Building upon previous systems research that has focused on local system clusters (Luke, 1992; Kania, 1993; Cueller & Gertler, 2003; Sikka et al, 2009), the contingencies and organizational structures of primary importance in this study relate to the location of the rural hospital and the geographic dispersion and hierarchical order of the system. This leads to the identification of four contingent relationships that will be measured simultaneously to determine a fit / congruence score for each rural hospital in the study.

### *Environmental Munificence and System Membership*

Before the specific configuration of a system cluster may be considered, the presence or absence of system membership must be accounted for. In the case of rural hospitals, the dominant environmental characteristic that drives system affiliation is resource munificence. Whether viewed through the theoretical lens of resource dependence (Alexander & Morrisey, 1989) or that of population ecology (Yarbrough & Powers, 2006), it is primarily the scarcity of critical resources that has driven the increase

in rural hospital inter-organizational relationships documented in recent studies (Moscovice & Stensland, 2002). All else being equal, hospitals would prefer to remain autonomous (Alexander & Morrissey, 1989), but when faced with increasing resource scarcity, hospitals will attempt to find a balance between autonomy, uncertainty over obtaining resources, and dependence on other organizations (Zuckerman, 1983; Cook et al., 1983). In other words, when resources in the form of investment capital, medical professionals, and patient reimbursement are readily available, rural hospitals would prefer to remain autonomous. But when adequate resources are not available in the local area, system membership allows rural hospitals access to additional resources and ensures their continued operation (Zuckerman, 1983; Mick et al, 1993). These additional resources may take the form of investment capital, increased bargaining power, or administrative expertise which can affect hospital efficiency and financial performance through increased emphasis on cost containment, the ability to increase prices, and increased use of health information technology (Mick et al, 1993; Berry et al, 1987; Trinh & Begun, 1999; Menachemi et al, 2005; Li et al, 2008). Thus system membership will have the greatest effect on hospital performance when the hospital is located in a market with low environmental munificence, and the contingent relationship between environmental munificence and system membership may be depicted as in Figure 2.

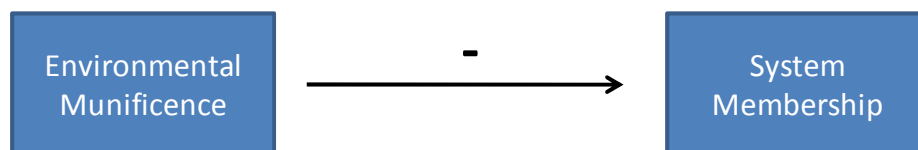


Figure 2 – contingent relationship #1

### *Hospital Location and System Configuration*

As demonstrated by the mixed results obtained in other empirical studies that use a dichotomous variable to represent system membership (Rothko et al., 2007), simply considering the presence or absence of system membership is not sufficient to uncover system performance effects. The location of the rural hospital and the configuration of the system to which it belongs are important factors in calculating how well system membership fits a particular situation. These two constructs may be further decomposed to produce two contingent pairs.

First, the location of a rural hospital and its proximity to other hospitals represent the level of direct competition that a rural hospital may face. In many hospital studies, market level competition is quantified by using a measurement of concentration such as a Herfindahl Index. The hospital market is often defined as the metropolitan area or the county in which the hospital is located, and the Herfindahl Index measures the extent to which a given service within that market is concentrated in the hospitals with the largest market shares (the Federal Trade Commission uses the four largest hospitals, but the number could vary depending on the market or the researcher). A score of one indicates a monopoly, a high score that is less than one indicates oligopolistic competition, and a low score indicates more open competition that is not dominated by any single competitor. However, in rural markets, there is generally only one hospital within a given county, micropolitan area, or non-core area, and Herfindahl scores calculated at the

market level would not be very useful. An alternative method to assess competition is to consider how close the rural hospital is to other rural hospitals.

Proximity to other hospitals increases direct competition for patients, but also creates an opportunity for system membership to provide a performance advantage, through the creation of local partners. Although some consolidation of administrative functions such as accounting, claims processing, and patient account management may be accomplished virtually for widely dispersed system hospitals, other functions such as medical supply distribution, laundry services, and potentially sharing physicians may only be centralized for system hospitals that are proximate to each other. This type of centralization allows multi-hospital systems to achieve economies of scale and reduce duplication associated with providing these services independently at each hospital (Carey, 2003). Further, common ownership converts competitors into partners, which should decrease competition between proximate hospitals, and allows them to coordinate and improve the efficiency of their marketing efforts (Dranove et al., 1996).

Thus geographic proximity to other hospitals is an important environmental contingency when considering the structure of a multi-hospital system. If hospitals are close to one another, then the multi-hospital system has the opportunity to create a hospital cluster (Luke, 1992), which is defined as two or more hospitals owned by the same system in the same market. Previous studies of the hospital industry have noted the development of such clusters (Cueller & Gertler, 2003; Kania, 1993) and their positive impact on hospital performance (Sikka, Ozcan, & Luke, 2007). In metropolitan areas a



hospital cluster may contain several hospitals, but in rural areas where the population density is lower and hospitals are more widely dispersed, a cluster may consist of just two hospitals that are located in adjacent or overlapping markets. These pairs of same system hospitals are often referred to as local system partners (Madison, 2004), and the concept of cluster management applies in the same way as it does to an urban cluster. Common system membership may facilitate the centralization and coordination of various services for hospitals that are located in close proximity to one another. This concept produces the second contingent relationship shown in Figure 3.

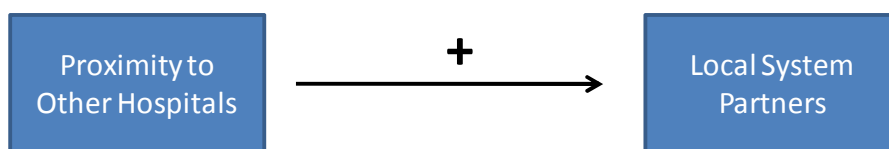


Figure 3 – contingent relationship #2

Rural hospital location also indicates how close a rural hospital is to larger hospitals that are primarily located in urban areas, but may also be rural referral centers (RRCs). Proximity to a larger hospital with more comprehensive services and perceived quality differences between urban and rural hospitals result in rural patients bypassing their local hospital (Radcliff et al., 2008; Saunders et al., 2009). Such behavior can negatively affect rural hospital patient volume and financial performance (Radcliff et al., 2008). Additionally, due to the small size and limited scope of services in most rural hospitals, patient transfers from rural hospitals to larger urban hospitals are quite common. The flow of patients from rural to urban areas links rural hospitals to larger urban facilities

and forces rural hospitals to expend precious resources to coordinate patient transfers and try and recapture patients that seek care out of the local area.

Once again, there is an opportunity for system membership to provide rural hospitals with a significant advantage by the creation of a system hierarchy. Hierarchy implies that there is a size and service scope difference between a system-affiliated rural hospital and its local system partner. Such a hierarchy supports the centralization and coordination of clinical services in addition to administrative and logistic services, and may be achieved when a rural hospital is in close proximity to a larger urban hospital or to a larger rural referral center (RRC). When this occurs, low volume specialty and sub-specialty services may be moved out of the rural hospital and consolidated at the larger system partner. The rural hospital niche width is reduced and it essentially becomes a specialty center (Yarbrough & Powers, 2006) focused on outpatient care, emergency room services, and high volume, low acuity surgical and inpatient services. The larger system partner becomes the generalist with a large niche width reflecting its wide scope of services. Such an arrangement capitalizes on the phenomena of out-shopping (Drain et al., 2001) by controlling the flow of patients from the rural area to adjacent urban areas and allows the rural hospital to close services where it does not have sufficient patient volume, and achieve productive efficiency by focusing their resources. Further, hierarchical system arrangements facilitate the routinization of patient transfers and sub-specialty referrals from rural facilities to their larger system partner, which should reduce the transaction

costs associated with each transfer. This logic results in the third contingent relationship related to rural hospital location and system configuration (Figure 4).

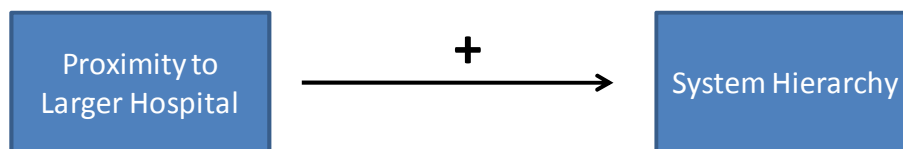


Figure 4 – contingent relationship #3

#### *CAH Status and Proximate Hierarchical System Partner*

The fourth contingent relationship specifically considers how rural hospital conversion to CAH status may interact with system membership. Previous research has shown that when compared to other rural hospitals, CAHs had greater transfer rates of ICU and non-ICU inpatients (Wakefield et al, 2006), exhibited greater cost inefficiency (Rosko & Mutter, 2010), and experienced less bypass behavior by local patients (Basu & Mobley, 2010). These differences make it logical to assume that CAH status may magnify the performance benefits of system membership and specifically hierarchical system configurations. Increased emphasis on cost containment associate with system membership could restore the efficiency incentive that was lost when CAHs switched from PPS to cost-based reimbursement. Further, a hierarchical system configuration which routinizes patient transfers would be most beneficial for CAHs that must keep their average length of stay less than 96 hours, and have increased pressure to transfer complex, high-acuity inpatients. Additionally, a hierarchical partnership should allow CAHs that are proximate to urban areas to further reduce patient bypass behavior, maintaining their advantage over rural PPS hospitals in this area. This should lead to

both increased efficiency and cost savings for CAHs that have a proximate hierarchical system partner compared to those that do not. Thus the contingency of CAH status should be positively related to having a proximate hierarchical system partner (Figure 5).

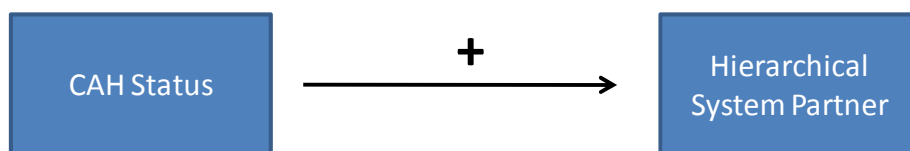


Figure 5 – contingent relationship #4

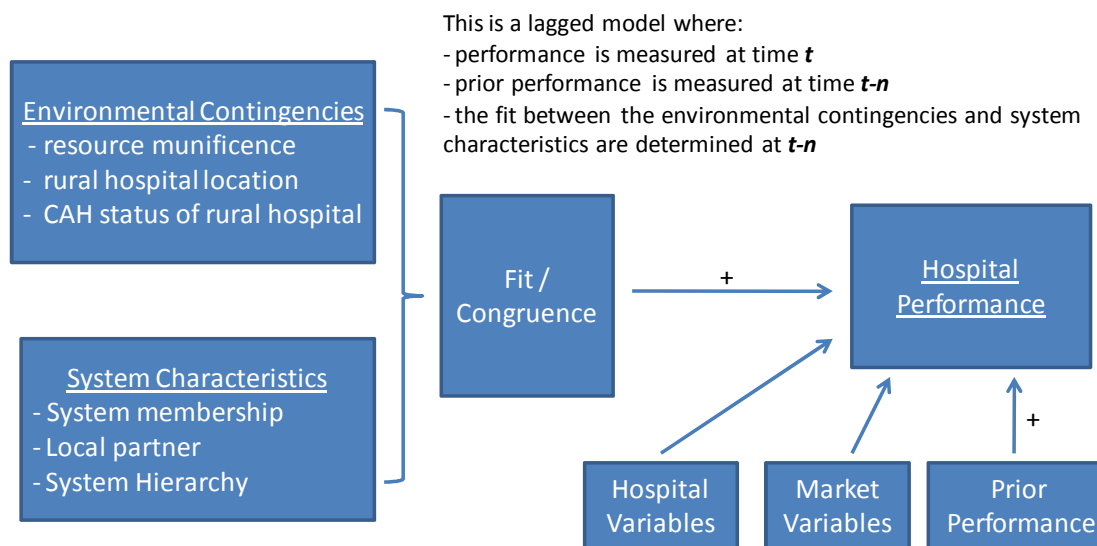
#### Conceptual Model and Hypotheses

The four contingent relationships outlined in the preceding paragraphs are aggregated together to produce the conceptual model for this study (figure 6). Note that as specified by contingency theory (Donaldson, 2001), it is the fit between the environmental contingencies and organizational structure that is related to organizational performance. The calculated degree of fit (or misfit) may be determined for each contingent pair individually, but a composite measure of fit/congruence may also be calculated, and some research suggests that a composite measure is more likely to explain organizational performance differences (Drazin & Van de Ven, 1985). In the conceptual model the fit/congruence box represents both the individual and composite measures of fit, which facilitates the generation of directional hypotheses for the composite model as well as each contingent pair.

In addition to the four contingent relationships that determine the degree of fit/congruence between the rural hospital's structure and the environment, a lagged measure of a hospital's prior performance and hospital and market control variables

shown to significantly influence efficiency and financial performance are included in the conceptual model which is graphically depicted in Figure 6. The lagged measure of prior performance is an important control variable in contingency theory models that controls for multiple determinants of performance that may not be directly observed (Donaldson, 1995). The hospital and market control variables account for factors that have been related to hospital performance in previous research.

### Contingency Theory Conceptual Model



This model addresses the question of performance – why would one rural hospital outperform another rural hospital – determined by fit between environmental contingencies and system characteristics.

Figure 6 – Conceptual Model for the Study

### *Hypotheses*

As previously mentioned, the fit/congruence construct in the conceptual model represents both the composite and individual fit/congruence measures for the four contingent relationships. In all cases, a higher degree of fit between the environment and

the structure of the system is positively related to hospital performance. Considering each contingent relationship individually, four hypotheses may be derived from the conceptual model.

The first hypothesis is based on the theorized relationship between resource scarcity and system membership. As previously discussed, system membership should be most beneficial for rural hospitals that are located in areas with the greatest resource scarcity. Therefore, system membership allows rural hospitals in these areas to fit their environment better than if they remained independent. This logic leads to the first contingent hypothesis:

**H1: Under conditions of greater resource scarcity, system-affiliated rural hospitals fit the environment better and will outperform stand-alone rural hospitals.**

The next two hypotheses are based on the environmental contingency of hospital location and the configuration of the hospital system to which a hospital belongs. For this study, hospital location is conceptualized as the proximity to other hospitals, and a distinction is made between proximity to other rural hospitals of similar size, and proximity to larger hospitals that offer significantly more services. System configuration is discussed in terms of dispersion and hierarchy, and applied at the market/local level with the concepts of local system partners and hierarchical system partners. These four concepts may be paired together to produce two contingent pairs which yield the following hypotheses:

**H2: When proximate to another hospital, system-affiliated rural hospitals with a local partner will outperform system-affiliated rural hospitals with no local partner.**

**H3: When proximate to larger urban hospitals or RRCs, rural hospitals with hierarchical system relationships will outperform those with non-hierarchical system relationships.**

The fourth hypothesis is based on the environmental contingency of CAH status which is paired with the system structural characteristic of hierarchy. CAH status is believed to alter the structure and behavior of a rural hospital in a manner that would fit best with a hierarchical system structure, and thus CAHs with hierarchical local system partners would fit the environment better than CAHs without hierarchical local system partners. Since a better fit should lead to better performance, the following hypothesis may be generated:

**H4: Critical Access Hospitals (CAHs) with proximate hierarchical system partners will outperform CAHs with no proximate hierarchical system partner.**

The reality for any organization is that fit is not determined by any one contingent pair, but by several contingent pairs simultaneously. Often in contingency theory based empirical work, hypothesis testing based on a single contingent relationship may not produce significant results, and instead multiple dimensions of fit must be considered simultaneously before significant results are obtained (Drazin & Van de Ven, 1985).

This does not mean that the individual measures of fit are not valid or are not important,

but that sometimes there is too much “noise” in the analysis to see a clear “signal” from one dimension of fit. For this reason, Donaldson (2001) recommends combining multiple measures of fit into composite measures. Following this advice, the four contingent relationships outlined in the preceding paragraphs may be considered simultaneously to create a composite measure of fit/congruence which should significantly influence hospital performance. This may be stated in a general hypothesis that directly relates the degree of fit to hospital performance, to produce the primary hypothesis for this study:

**H5: Rural hospital performance is positively related to the degree of fit between the rural hospital’s multi-hospital system structure and its environment.**

#### Summary of Theoretical Framework

The theoretical framework for this study is based on contingency theory which has been suggested as an appropriate framework for studying the effects of strategic choices like joining a multi-hospital system (Smith & Piland, 1990). Rather than relating a specific environmental or organizational characteristic to organizational performance, a contingency theory framework emphasizes the fit between an organization’s structure and its environment, and proposes that performance depends on the degree of fit or congruence between the dominant environmental characteristic(s) and the structure of the organization (Donaldson, 1995; Scott & Davis, 2007). Thus differences in organizational performance among organizations may be explained by differences in fit, and assessing fit becomes central to empirical work that uses contingency theory.



To conceptualize and ultimately measure the fit / congruence between organizational structure and environment, contingent relationships must be specified. Four such relationships are specified for this study based on the environmental contingencies of resource munificence, hospital location, and CAH status. These are paired with the system structural characteristics of system membership, system dispersion, and system hierarchy. Combined with control variables that account for hospital prior performance, significant market characteristics, and other hospital characteristics that are not related to system membership, these contingent relationships produce a conceptual model that relates fit/congruence to hospital performance.

From the conceptual model five hypotheses are derived; one for each contingent relationship and a composite hypothesis which considers all four contingent relationships simultaneously. Each of these hypotheses will be tested by regressing hospital performance on the fit/congruence score calculated for the four contingent relationships in the conceptual model. The identification and measurement of variables that represent the constructs in the conceptual model and the analytic methods for hypothesis testing are discussed in the next chapter.

## CHAPTER 4 – METHODS

This chapter discusses the research design, data sources, study sample, variable definitions, and analytic methods for the study. Particular attention is paid to the Data Envelopment Analysis (DEA) technique used to derive one of the dependent variables as well as the calculation of the fit / congruence score for each hospital, which is the independent variable that is directly related to organizational performance in contingency theory research. Limitations of the study methods are discussed at the end of chapter.

### Research Design

This study uses a non-experimental, non-equivalent groups post-test design with multiple cross-sections. This design is depicted in Figure 7, which also highlights three additional aspects of the study design and variable measurement. First, the study period covers 2004 to 2008, with the independent variables measured in 2004 and the dependent variables measured in 2006 to 2008. In accordance with Donaldson's (2001) recommendations for empirically testing contingency theory relationships, there should be a lag between fit/congruence measures and performance measures. Therefore hospital observations will be constructed using variables involved in measuring fit/congruence from 2004 and dependent performance measures from 2006 to 2008. This establishes temporal precedence between the independent and dependent variables and addresses the problem of endogeneity. Second, hospital system membership does not change during

### Non-experimental Post-Test Design with Multiple Cross-Sections

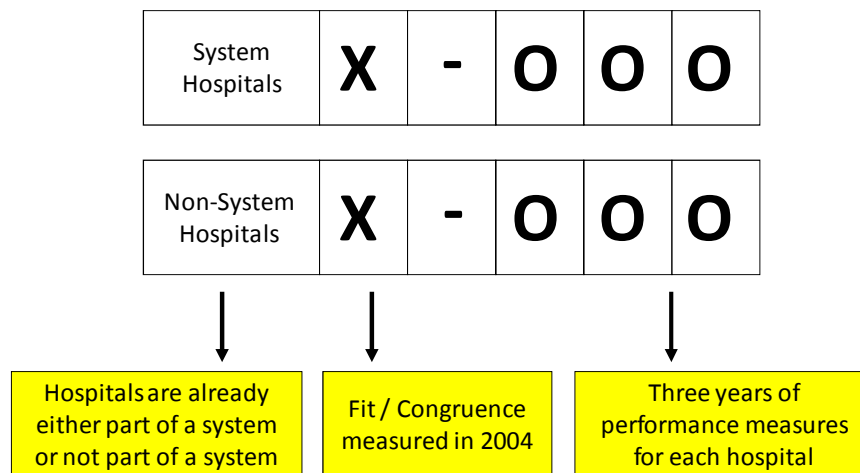


Figure 7 – Research design for the study

the study period. The rural hospitals in the sample are either part of a system or not part of a system at the beginning of the study period. Hospitals that change system membership during the study period are excluded. Third, three years of dependent performance variables are used to minimize the influence of large, one-time capital expenditures or other accounting abnormalities that may skew the results. Using three years of dependent variables does not make this a longitudinal study since longitudinal analysis methods are not used, but it is an improvement over a simple cross-sectional design.

#### *Threats to Internal and External Validity*

The non-equivalent groups post-test only design used in this study is a common design in social research where study participants are usually not randomly assigned to the two groups. However, this study design is subject to some threats to internal validity that limit its ability to establish causality. Potential threats include selection bias, history,

maturation, testing, instrumentation, mortality, regression, and various social threats. Each threat is either eliminated by the study design or may be minimized and controlled through argument, by measurement, or by statistical analysis (Trochim & Donnelly, 2008). Each potential threat to internal validity and how it will be minimized or controlled are discussed in the next few paragraphs.

Threats that are eliminated by the study design are testing, instrumentation, regression, and social threats. Testing and instrumentation threats occur when a pre-test influences one group differently from the other or when there is a change in the test instrument for one group but not the other. Neither of these threats apply to this study because a pre-test is not used, and the instruments used to collect the data (AHA survey, CMS reports, etc...) are identical for all hospitals. A regression threat, often referred to as regression to the mean, refers to the tendency of post-test measures to return to population averages. A regression threat is most likely when the groups used in the study are selected based on pre-test scores (i.e. low performers are put in the treatment group and high performers are put in the comparison group). Again, this study does not use a pre-test and the groups are not selected based on pre-test scores, so a regression threat is not a concern. Finally, social threats to internal validity arise when the treatment, control, and/or comparison groups are aware of the study and have knowledge of the treatment that another group is receiving. Awareness of the study conditions may cause them to imitate the treatment that another group receives, compete against other groups in terms of outcome variables, or become demoralized if they are not receiving the most beneficial

treatment. This is a retrospective study that uses secondary data, and the hospitals involved were not aware of the study when the data was collected and therefore social threats to internal validity do not apply.

The threats to internal validity that remain are selection bias, history, maturation, and mortality threats. Selection bias involves differences between the two study groups prior to the study period, while history, maturation and mortality threats involve differences between the two study groups during the study period. The threats that occur during the study period will be addressed first. A history threat is when a discrete event affects one group but not the other group, a maturation threat is when one group naturally improves at a different rate than the other group, and a mortality threat occurs when study participants are differentially eliminated from one group during the study period causing the two study groups to become statistically non-equivalent. The use of control variables to account for performance differences associated with hospital and market characteristics minimizes the potential of history and maturation threats. Additionally, unobserved history threats such as changes in state Medicaid policy or regional variations in economic activity are controlled because both groups contain hospitals from the same census divisions, states, and local communities. Thus discrete events at the regional, state, or local level would affect both groups equally. Measuring the dependent variable over multiple time periods also helps to further minimize any type of maturation threat.

A mortality threat is possible, because hospitals that change system status or CAH status during the study period are deleted from the study sample. Descriptive statistics

will be used to compare the hospitals that are deleted from the study sample to the hospitals that remain in the study sample. Significant statistical differences between the two groups may indicate if a mortality effect exists, and how it potentially affects the results of the study.

The final threat to internal validity, the presence of a selection bias, is the greatest threat to this study and is caused by the fact that hospitals are not randomly assigned to the system and non-system groups. Because hospitals are not randomly assigned, there is the possibility that the hospitals that joined systems are systematically different from those that did not. Often, social science research relies on pre-test measures to establish the statistical equivalence of the different groups, but in this case the treatment (hospitals joining a system) is not a discreet event, and the prolonged time period over which rural hospitals joined systems makes obtaining “pre-test” measures and establishing statistical equivalence difficult. Without establishing statistical equivalence the threat of selection bias cannot be completely controlled, but the following aspects of this study help to minimize the threat. First, this study measures the relationship between fit and performance not the relationship between system membership and performance. So even though the study design shows the two groups as system and non-system hospitals, the hypotheses that are tested actually compare hospitals with good “fit” against hospitals with bad “fit”, and these groups include both system and non-system hospitals. Therefore a selection bias based on system membership would affect both the “fit” and “misfit” groups which are being compared in the analysis. Second, the analysis

techniques used to test the hypotheses calculates coefficients that show the performance difference between hospitals in the “fit” and “misfit” categories. Following the logic presented in the theoretical framework of the study, hospitals in the “fit” category should outperform hospitals in the “misfit” category, and the leaders of hospitals in the “misfit” category should take action to improve the fit between their hospital structure and the environment. However, hospitals that change system membership and CAH status during the study period are excluded from the sample. Theoretically these hospitals should be the worst performing hospitals, and their exclusion from the study sample should raise the mean performance of the “misfit” group, and decrease the size of the coefficient produced during hypothesis testing. Thus the calculated coefficients used to test the hypotheses would be attenuated toward zero, making it harder to obtain any significant results. Finally, descriptive statistics from the first year of the study (2004) will be used to compare system to non-system hospitals and hospitals with consistent system membership to hospitals that change system membership. Assuming that there are not significant differences based on unobserved variables, this supplementary analysis will help to identify if a selection bias exists based on the study variables and how it may possibly affect the dependent variables.

The threats to internal validity and control measures employed in this study to control these threats are summarized in Table 1.

In addition to the threats to internal validity, the generality of the study may be limited if there are significant threats to external validity. Threats to external validity

Table 1. Threats to Internal Validity

Threat	Present in the Study	Control if Present
Selection Bias	Yes	This study measures the affect of fit on performance, not the effect of system membership on performance, so a selection bias based on system membership should not invalidate the study results. The exclusion of hospitals that switch system status during the study period should bias the calculated coefficients downward and thus make it more difficult to obtain significant results. Descriptive statistis will be used to compare hospital groups to help identify if a selection bias exists.
History	Yes	Many history threats are nullified by the use of control variables. Additionally, both groups contain hospitals from the same census divisions and states so non-experimental events that are not represented by control variables (i.e. changes in state or national policy) should effect both groups equally
Maturation	Yes	Use of control variables and dependent variables are measured multiple times
Testing	No - this only applies to pre/post-test designs	N/A
Instrumentation	No - this only applies to pre/post-test designs	N/A
Mortality	Yes	Descriptive statistics will be used to compare hospitals that drop out of the study to the hospitals that remain
Regression to the Mean	No - groups are not selected based on a pre-test	N/A
Social Threats	No - this is a retrospective study performed with secondary data	N/A

usually arise when the study sample, the study setting, or the study time period are not representative of the population (Trochim & Donnelly, 2008). These are not significant issues for this study. This study uses a national sample of rural hospitals and the exclusion criteria that are applied strike a balance between maximizing the study sample and controlling threats to internal validity. The study sample and the exclusion criteria are discussed more fully in the subsequent section on the study population and sampling strategy.



## Data Sources

Data will be combined from the AHA Annual Survey of Hospitals, the Medicare Hospital Cost Report Information System Minimum Data Set (HCRIS MDS), and the Area Resource File (ARF) to create the data set for the study. The AHA annual survey data will be augmented with data on hospital systems collected by Dr. Roice Luke, who contacts individual hospitals and hospital systems directly to clarify system relationships that are not clear in the AHA data.

The majority of the variables used in the study are taken from the AHA annual hospital survey. These include number of staffed beds, ownership type, teaching status, Medicare payer percentage, Medicaid payer percentage, number of staffed beds, non-physician FTEs, non-labor expense, and service mix (which is a weighted count of the services provided by the hospital in the AHA survey). These variables are used in various ways that include calculating the measure of fit/congruence for each hospital, calculating the dependent DEA efficiency score for each hospital, and as control variables. Additionally, the latitudes and longitudes for each hospital listed in the AHA survey data are used to determine the distance of each rural hospital from other hospitals and from the closest urban area.

Environmental / market characteristic measures are taken from the 2008 ARF data set. The ARF contains numerous variables collected by government and private organizations at the county level. For this study, the variables per capita income and unemployment rate will be used as measures of resource munificence for the county in

which a hospital is located. Additionally, in accordance with recommendations for contingency theory empirical work by Lex Donaldson (2001), these same variables will also be used as market characteristic control variables in the regression analysis. The inclusion of these variables as controls demonstrates that the effect of fit on performance is distinct from any relationship that the contingency or structural characteristic variables may have with hospital performance (Donaldson, 2001).

Data from the HCRIS MDS are used to calculate the financial performance measure for each hospital, which is hospital total margin. Total margin is a financial ratio calculated by dividing hospital net income by hospital total revenues (the sum of hospital patient revenue and other hospital revenues). The variables required to calculate this financial ratio are from HCRIS MDS worksheet G-3.

The data elements from these three sources will be merged together using the hospital ID number, the name of the county and state in which the hospital is located, and the FIPS / modified FIPS code.

### Study Population and Sampling Strategy

The study population consists of all non-federal, acute care rural hospitals within the United States from 2004 until 2008. For this study, the term “rural hospital” is defined as all non-metropolitan statistical area hospitals, and includes hospitals located in both micropolitan and non-core/rural areas under the OMB statistical area definitions. The sampling strategy for this study is very simple: maximize the size of the study sample. Since this study uses secondary data which are available for the vast majority of hospitals

in the United States, there is no cost associated with data collection. Therefore, the study sample will include all rural hospitals for which data are available, and will be as close to the study population as possible. The following paragraphs discuss the exclusion criteria that were applied to construct the study sample, and identify how many hospitals were dropped from the sample for each criterion. This information is summarized in Table 2.

**Table 2. Sample Exclusion Criteria (number of hospitals excluded)**

	Number of Hospitals	
	Efficiency Score	Total Margin
Number of Rural Hospitals Consistently in the AHA Hospital Survey 2004-2008	2170	2170
Exclusion Criteria:		
Federal Government Ownership indicated by AHA Control Code	(59)	(59)
Other than General Medical / Surgical Hospital indicated by AHA Service Code	(142)	(142)
Long-term care hospitals indicated by AHA length of service code	(9)	(9)
Hospital Staffed Bed Size less than 10	(20)	(20)
Hospital coded as a Rural Referral Center (RRC)	(242)	(242)
Missing Data*	(243)	(248)
Nonsensical and Extreme Data Values	(30)	(30)
Deleted hospitals located in US Territories	(4)	(4)
Hospitals deleted because AHA measures were estimated not reported	(235)	(235)
Change in System Membership from 2004 to 2008	(80)	(79)
Change in CAH Status from 2004 to 2008	(96)	(95)
<b>Final Sample Size</b>	<b>1010</b>	<b>1007</b>

\* Five hospitals were missing the HCRIS data required to calculate total margin, so the sample size is slightly different for the two dependent variables

First, construction of the study sample begins with the total number of rural hospitals listed in the AHA annual survey from 2004 to 2008 (n=2170). Then federal government hospitals (those with a control code of 41-48 in the AHA data base), hospitals that were not general medical / surgical hospitals (those with a service code other than 10 in the AHA data base), and long-term care hospitals were excluded. Next, the bed size for each hospital was reviewed and the extremely small hospitals (staffed bed size less than 10) were deleted from the study sample. These extremely small hospitals may function more

like outpatient clinics than true hospitals. At the other end of the spectrum are rural referral centers (RRCs) which are the largest of the rural hospitals. The RRC program was established by CMS as part of the PPS in 1983, and provides higher reimbursement levels for large rural facilities that treat patients on a regional or national basis (McCue & Nayar, 2009). These hospitals operate more like large urban hospitals rather than rural hospitals; therefore they are deleted from the sample. This left the sample at  $n = 1698$ .

The data for the remaining hospitals were examined to identify hospitals with missing data elements, extreme values, and/or nonsensical data values. When missing data elements were discovered, they were replaced with data from another source where possible (i.e., a missing AHA data element was replaced with a HCRIS MDS data element) in order to retain as many hospitals as possible in the sample. Missing AHA data resulted in the deletion of 234 hospitals and an additional five hospitals were deleted due to missing HCRIS data<sup>2</sup>. However, several of the hospitals in the AHA survey data were not simply missing one or two data elements, but instead contained only estimated values rather than reported values for one or more years in the study period. Hospitals which had estimated values for one or more years of the study period were deleted. Extreme values were defined as values that were more than three standard deviations from the variable mean, and were handled on a case by case basis. When an extreme value was identified, all other information for a given hospital was considered, if the extreme value did not seem plausible then the observation was deleted from the study

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<sup>2</sup> Note that this resulted in two different sample sizes for the two dependent variables, since the HCRIS data was only needed in the analysis involving the financial dependent variable. This is reflected in Table 2 by the two different columns of numbers – one for each dependent variable.

sample. Examples of this are when labor expenses for a hospital exceed the hospital's total expenses, or when the non-labor expenses for a hospital in one of the study years is more than 10 times greater than its non-labor expenses in the other study years. Finally, the data were inspected for nonsensical values, which are letters when the variable is supposed to be a number or entries such as "999," which usually indicate missing information, but none were found. Additionally, when the data was inspected it was discovered that there were four hospitals from U.S. territories (Guam, American Samoa, and the Virgin Islands), these were also deleted from the study sample. Application of these exclusion criteria reduced the study sample to n=1186 short-term, general/acute care rural hospitals with complete data for the study period (1181 for the dependent variable total margin).

The final step in the process was to examine the system membership variable for each hospital from 2004 to 2008. Since fit/congruence is measured in 2004 and performance is measured in 2008, the system membership for each hospital must remain constant from 2004 to 2008. The same goes for the CAH status variable, which is also used in the calculation of the fit/congruence score. If these variables changed during the study period, then the hospital was deleted from the study sample. Once these actions were completed, the final sample for the study was n=1010 short-term, general/acute care rural hospitals with constant system and CAH status during the study period (n=1007 for the dependent variable total margin).

## Measurement of Variables

In accordance with the conceptual framework presented in Chapter 3, this study uses the constructs of hospital performance and the degree of fit between environmental characteristics and organizational structure, to analyze the effects of system membership on rural hospitals. This section explains how these constructs are operationalized into dependent and independent variable measures, and combined with organizational and market level control variables in order to conduct inferential testing of the stated hypotheses. A table at the end of this chapter summarizes all of the variables.

### *Dependent Variables*

Hospital performance is a multi-faceted concept which includes financial performance, efficiency, the quality of care, and patient safety. This study focuses on economic performance and uses two dependent variables to operationalize the construct of performance. The first, hospital total margin is a financial performance measure, and the second, hospital productive efficiency, is a measure of efficiency.

#### *Hospital Financial Performance*

The first dependent variable is hospital total margin. For this study, total margin is defined as hospital net income divided by hospital total revenues. Hospital total margin is a financial ratio that measures organization profitability, and is one of the most frequently used indicators of hospital financial performance (Flex Monitoring Team Paper No 7, 2005). This measure is calculated using HCRIS MDS data from Worksheet G-3. More specifically, line 31 (hospital net income) is divided by the sum of line 3

(patient revenue) and line 25 (other hospital revenue). Because hospital total margin is a ratio, it may be compared across hospitals of different size. Additionally, it was rated as the most useful measure of profitability by a sample of hospital CEOs surveyed by the Flex Monitoring Team (Paper No 7, 2005).

To reduce the influence of accounting aberrations within a given year, three years of hospital total margin are averaged together to produce the financial performance dependent variable. This is a common technique in hospital financial analysis (McCue, 2007) and minimizes the impact of one-time accounting events.

### *Hospital Efficiency*

The second dependent variable is a hospital efficiency score generated by Data Envelopment Analysis (DEA). DEA is a non-parametric technique developed by Charnes, Cooper, and Rhodes (1978) for studying production efficiency among a group of organizations or other sampling units. DEA considers multiple inputs and outputs simultaneously, and identifies an efficiency frontier that represents the optimal efficiency relationships among inputs and outputs for a sample of organizations. It has been used extensively by health services researchers to study various health care organizations, including several hospital and multi-hospital system efficiency studies (Ozcan, 2008; Ozcan & Luke 1993; Ozcan & Luke, 2011; Lynch & Ozcan, 1994; Sikka et al, 2009). In DEA, the organizations being studied are referred to as decision making units (DMUs), and linear programming is used to calculate an efficiency score for each DMU. The most efficient DMUs within a given sample are assigned a score of “1” and the other

less efficient DMUs within the sample receive an efficiency score between “0” and less than “1” relative to the efficient DMUs. .

For this study a four input and five output, input-oriented, constant returns to scale model will be used to generate efficiency scores for each hospital over the five year study period. Two basic assumptions about the nature of the work that hospitals perform underlie this model. First, an input-oriented model assumes that inputs are easier to control than outputs. This reflects the reality of hospitals, where organizational leaders have more control over the staff and physical resources that they put into patient care than the volume of the patient care itself. The second assumption, indicated by the choice of a constant returns to scale (CRS) model, is that the return on a given input(s) is constant as the amount of that (those) input(s) increases. This assumption is common in empirical studies which use DEA to study hospital efficiency when there is no evidence to suggest that variable returns to scale are present (Ozcan & Luke, 2011). Additionally, CRS models incorporate both scale efficiencies and variable returns to scale, and avoid inflation of the hospital efficiency scores which is sometimes seen in VRS models (Sikka et al., 2009).

DEA models for general hospitals generally contain inputs that measure capital investments, labor, and operating expenses, and outputs that reflect both inpatient and outpatient production (Ozcan, 2008, pg106). These categories for inputs and outputs have been consistently operationalized using a mixture of AHA and CMS Cost Report data in a model with four inputs (Bed Size, Service Mix, non-physician FTEs, and Non-



Labor Expenses) and two or three outputs (Case-Mix Adjusted Admissions, Total Outpatient Visits, and sometimes Teaching FTEs) (Ozcan, 2008, pgs 106-108; Nayar & Ozcan, 2008; Ozcan & Luke, 2011; Ozcan & Lynch, 1992; Sikka et al., 2009).

However, studies involving critical access hospitals use slightly different models because CAHs do not report DRG information to CMS, so there is no case mix index with which to adjust the admissions. Therefore multiple efficiency studies involving CAHs use a mix of total inpatient days, surgical procedures, births, emergency room visits, and other outpatient visits as a way to overcome the fact that admissions are not case-mix adjusted (Harrison et al., 2009; Butler & Li, 2003; Rosko & Mutter; 2010). This different mix of outputs accounts for some of the difference in services and intensity required by different patients that is usually part of the case-mix adjustment. Additionally, DEA models involving CAHs usually do not contain teaching FTEs as an output because less than 1% have residency training programs and only a few facilities have any real teaching output. Further, studies by Valdmanis (1992) and Ozcan (1992) have indicated that DEA model results are relatively insensitive to the inclusion of teaching variables as an output. Thus the model for this study is a four input and five output model using the following variables:

**Input 1** – Staffed Hospital Beds (Beds) – number of staffed hospital beds in the facility

**Input 2** – Weighted Service Mix (ServMix) – a weighted count of all clinical services that the hospital provides. Services are weighted based on their clinical and investment intensity in accordance with the method developed by Ozcan & Luke (2011)

**Input 3** – Non-Physician FTEs (FTE) – the total employee FTEs for the hospital

**Input 4** – Non-Labor Expenses (NLE) – total operating expenses minus payroll expenses expressed in 2008 dollars

**Output 1** – Total Admissions (ADMTOT) – total number of inpatient admissions for the facility

**Output 2** – Births (Births) – total number of live births in the facility

**Output 3** – Total Surgical Procedures (SUROPTOT) – total number of both inpatient and outpatient surgical procedures for the facility

**Output 4** – Emergency Room/Department Visits (VEM) – total number of outpatient visits to the emergency room or department in the facility

**Output 5** – Other Outpatient Visits (VOTH) – total number of non-emergency room outpatient visits

As with the financial performance dependent variable, the efficiency scores for each hospital are averaged for the three year period 2006 to 2008 in order to reduce the effect of aberrant accounting data within a given year. Thus the efficiency dependent variable is the average productive efficiency for the hospital from 2006 to 2008, and will range from 0 to 1. Chilingierian (1995) points out that the DEA scores are essentially a censored variable, where organizations that would hypothetically score higher than 1 are instead assigned a maximum score of one. Following Chilingierian's example, the DEA efficiency scores will be transformed  $((1/\text{DEA Score}) - 1)$  so they may be analyzed using a Tobit model, which is a regression model for dependent variables that are censored at

zero but are roughly continuously distributed over strictly positive values (Wooldridge, 2009).

### *Independent Variables*

The measure of fit/congruence is the primary variable of interest in contingency theory models and is calculated by matching environmental contingency measures and organizational structure measures in contingent pairs. As illustrated in the conceptual model, the environmental contingencies are resource munificence, hospital location, and CAH status, and the system structural characteristics are system membership, local partners, and system hierarchy. The following paragraphs detail how these characteristics are operationalized with variable measures and how the fit/congruence score is calculated. One important point to note is that in order to calculate the fit/congruence scores that are essential to this contingency theory based study, environmental contingency values must be matched with organization structure values in order to determine how well the organizational structure fits the environment (i.e. are they congruent or incongruent). Since the organizational structure measures are dichotomous variables (system membership or independent, local partner or no local partner, hierarchical system or non-hierarchical system) then the environmental contingency measures must be transformed into binary variables in order to calculate the fit/congruence score. Therefore, the measures for environmental munificence and distance between hospitals which are continuous variables, will be transformed into categorical variables to correspond to the structural measure to which it is paired.

### *Environmental Contingencies*

The first environmental contingency is resource munificence, which refers to the ability of the environment to sustain the hospital and may be represented by the number of potential patients and strength of the local economy (Mick et al, 1993). For this study resource munificence is conceptualized in terms of overall economic condition of the rural market and potential patients. These pieces of the concept of resource munificence will be measured using the ARF variables per capita income and unemployment rate. Per capita income and unemployment rate represents the overall economic condition of the rural area, and unemployment rate is also a measure of potential patient volume since most people in the United States obtain health insurance from their employer. Factor analysis will be used to create a single resource munificence variable from these measures<sup>3</sup>. This variable will then be divided into quartiles and the hospitals in the top quartile will be coded as high resource munificence and the hospitals in the bottom quartile will be coded as low resource munificence. This will exclude the hospitals in the middle two quartiles from the analysis of the first hypothesis.

As indicated in chapter three, hospital location is decomposed into two proximity measures that indicate how close the rural hospital is to other hospitals and how close it is to a larger hospital. Proximity to another hospital is a dichotomous variable coded “1” if

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<sup>3</sup> Initially a four variable measure of resource munificence was proposed using the variables per capita income, unemployment rate, population density, and active physicians per capita. However, when factor analysis was performed in order to produce a consolidated measure of resource munificence, the four variables would not converge into a single factor solution. Regardless of the rotation technique employed, the four variables clearly contained two underlying factors of resource munificence. Since a single factor solution was necessary to calculate the fit/congruence score for hypothesis testing, the number of variables used to measure resource munificence was reduced to two: per capita income and unemployment rate.

there is another hospital within 50 miles and zero otherwise. Previous studies examining local hospital clusters and local system partners have used distances of 60 miles (Luke, 1992) and 70 miles (Young et al., 2000), and the geographic isolation requirement necessary to qualify for CAH status is 35 miles, so 50 miles strikes an even balance between these previously used criteria. Proximity to a larger hospital is also a dichotomous variable coded “1” if there is a hospital with greater bed size and specialty/sub-specialty services within 50 miles and zero otherwise. The final environmental variable is CAH status, which is a dichotomous variable indicating the CAH status of the rural hospital. This variable is coded “1” if the hospital is a CAH and zero otherwise.

#### *System Configuration / Structure*

There are three hospital system structural characteristics that correspond to the four environmental measures discussed in the preceding paragraph. They are system membership, local system partner, and system hierarchy. System membership is an indicator variable coded 1 if the hospital belongs to a multi-hospital system and zero otherwise. Local system partner and system hierarchy are also indicator variables. A local system partner is defined as a hospital within 50 miles that belongs to the same hospital. If there is another system hospital within 50 miles, then the variable for local system partner is coded 1. System hierarchy means that there is a hospital with greater bed size and specialty/sub-specialty services owned by the same system within 50 miles. If a system hierarchy does exist, then this variable is coded 1, otherwise it is coded zero.

### *Calculation of the Fit/Congruence Scores*

In an approach similar to that of Van de Ven and Drazin (1985), the fit/congruence scores for each contingent pair will be examined first (H1 through H4), and then a composite fit/congruence score will be created to test H5. Calculation of the individual and composite fit/congruence scores are discussed in the remainder of this section.

To calculate the individual fit/congruence scores, four contingent pairs are created. Resource munificence will be paired with system membership, proximity to another hospital will be paired with local system partner, proximity to a larger referral hospital will be paired with system hierarchy, and CAH status will be paired with system hierarchy. Each pair creates a 2 x 2 matrix (shown in Figure 8), dividing the hospitals in the sample into four groups (three groups for two of the matrices). A set of indicator variables will be created for each characteristic pair, and these dummy variables will be used to test hypotheses one through four.

Each 2 x 2 matrix shows the possible combinations for each pair of environmental and system characteristics and to the right of each matrix is the set of dummy variables that will be created to test each hypothesis (H1 through H4). The reference category for each hypothesis test and the hypothesized group differences are also indicated to the right of the matrix. One important thing to note about the fit/congruence scores and the accompanying hypotheses is that there is no assumption of equifinality or iso-performance. Iso-performance implies that all fits are equally as good (Donaldson, 2001). This means that for each value of the contingency there is a value for

**Resource Munificence / System Membership 2 x 2**

Resource Munificence	High	Group 3	Group 4
	Low	Group 1	Group 2
		No	Yes
		System Membership	

Four Variables are Created

Group 1 - Low Resources, No System (reference category for H1)

Group 2 - Low Resources, System

Group 3 - High Resources, No System

Group 4 - High Resources, System

H1: Performance of Group 2 > Group 1

**Proximity to Other Hospital / Local Partner 2 x 2**

Proximity to Other Hospital	Yes	Group 2	Group 3
	No	Group 1	N/A
		No	Yes
		Local Partner	

Three Variables are Created

Group 1 - Not Proximate, No Local Partner

Group 2 - Proximate, No Local Partner (reference category for H2)

Group 3 - Proximate, Local Partner

H2: Performance of Group 3 > Group 2

**Proximity to Larger Hospital / Hierarchy 2 x 2**

Proximity to Larger Hospital	Yes	Group 2	Group 3
	No	Group 1	N/A
		No	Yes
		Hierarchy	

Three Variables are Created

Group 1 - Not Proximate, No Hierarchy

Group 2 - Proximate, No Hierarchy (reference category for H3)

Group 3 - Proximate, Hierarchy

H3: Performance of Group 3 > Group 2

**CAH Status / Hierarchy 2 x 2**

CAH Status	Yes	Group 3	Group 4
	No	Group 1	Group 2
		No	Yes
		Hierarchy	

Four Variables are Created

Group 1 - Not a CAH, No Hierarchy

Group 2 - Not a CAH, Hierarchy

Group 3 - CAH, No Hierarchy (reference category for H4)

Group 4 - CAH, Hierarchy

H4: Performance of Group 4 > Group 3

Figure 8 – Fit/Congruence 2 x 2 Matrices and Groups for Analysis

organizational structure that will result in the highest performance. Using the contingent pair of resource munificence and system membership as an example, this means that the level of performance produced when a system hospital is in a low munificence area would be the same as the level of performance of a non-system hospital in a high munificence area. Although none of the hypotheses specifically identify which groups should be equal, the concept of iso-performance will be addressed as part of the discussion of the results of this study.

A combined fit/congruence score will be used to test the overall hypothesis (H5) that better fit between rural hospital system affiliation and environment positively affects hospital performance. However, it may be more appropriate to call this a measure of misfit rather than fit. Due to concerns about iso-performance and the potential for multiple groups to have the same “fit”, the combined fit/congruence score will be based on the combinations of the environmental contingencies and the organizational structures that result in the worst fit or misfit. These are clearly identifiable and are indicated in Figure 9. Hospitals that fall into one of the misfit areas will be assigned a score of 1 and all other hospitals will receive a zero. Since there are four contingent pairs, the maximum score a hospital could receive is 4, indicating that it is a misfit in four dimensions. The composite misfit scores will range from zero (indicating that the hospital is not a misfit in any contingent pair) to four, and a lower score should be associated with greater performance. This composite measure also assumes equal



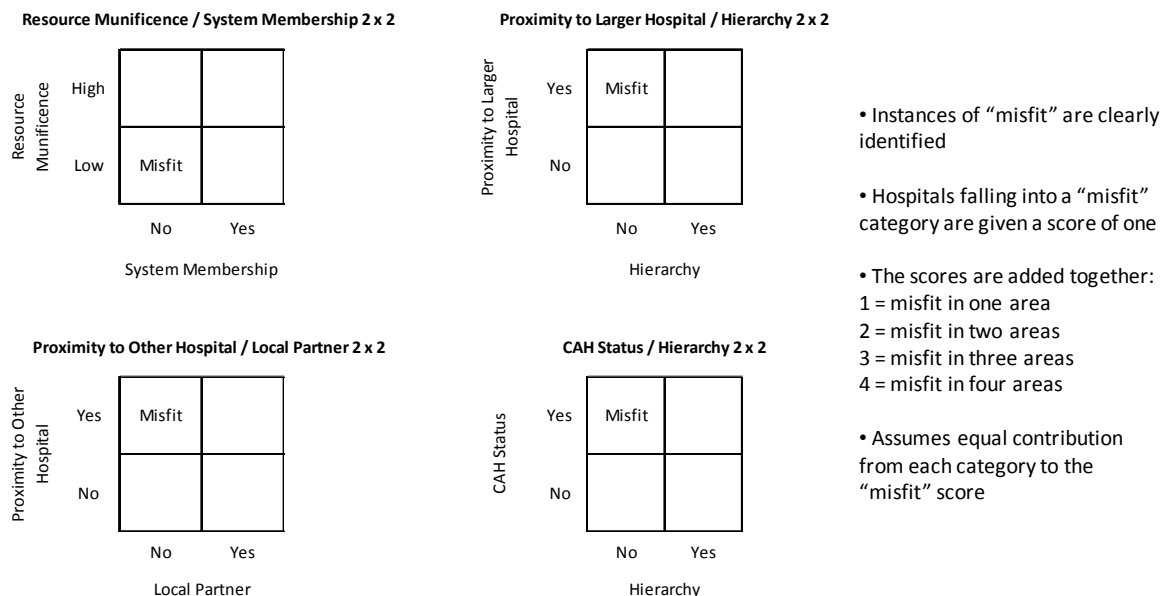


Figure 9 – Calculation of the composite measure of fit/congruence

contributions from each contingent pair, so no contingent pair influences the composite measure more than another. In reality this may not be the case, and a separate analysis using the four individual misfit scores will be conducted to test the equal weight assumption for the composite measure, and potentially adjust the calculation of the composite fit measure.

*Control Variables*

Control variables for this study consist of a lagged measure of hospital performance and two sets of control variables for hospital and market characteristics that have been shown to affect hospital performance. As Donaldson (2001) suggests in his guidelines for conducting empirical work with contingency theory, a lagged dependent variable and the environmental characteristics used in the fit/congruence calculation are included as controls in the analytic model. The lagged measure of hospital performance controls for

unobserved time-invariant factors like political climate and organizational culture which may impact performance. As with the dependent variables, to minimize the influence of aberrant accounting information within a given year, the lagged dependent control variable will be a three year average from 2002 to 2004.

The hospital control variables hospital size, ownership type, teaching status, Medicare payer percentage and Medicaid payer percentage will be included to control for hospital characteristics which have been related to hospital performance in empirical research (Zhao et al, 2008; Chukmaitov et al., 2009; Pervaiz et al., 2008; Shen et al., 2007; Wang et al., 2001a; Younis, 2006). Similarly, a set of environmental/market characteristics taken primarily from the ARF will be included to control for environmental factors that may have an impact on efficiency and financial performance. The measures of per capita income and unemployment rate will be included as control variables representing environmental munificence. Additionally, a set of indicator variables for the U.S. Census Bureau divisions will be included as an environmental control variable to account for geographic differences identified in previous studies (Pink et al., 2006; Wang et al., 2001; Younis, 2006; Mick et al, 1993; Reardon, 1996). Where appropriate, a three year average (2006 to 2008) will be used so the control variables match the dependent variables (some data are not available for unemployment rate and per capita income, so a two year average is used). Table 3 summarizes all of the variables used in this study and identifies their source.

Table 3. Study Variables

Variable	Measurement	Data Source
<b><u>Dependent Variables</u></b>		
Hospital Total Margin (3 year average)	Net Income / Total Revenue (2006 to 2008)	HCRIS / AHA
Hospital Efficiency (3 year average)	DEA Efficiency Score (2006 to 2008)	Calculated
<b><u>Variables Used in Calculating the DEA Efficiency Score</u></b>		
Staffed Hospital Beds	Number of staffed beds in the facility	AHA
Weighted Service Mix	Weighted count of clinical services that the hospital provides (weighted per Ozcan & Luke, 2010)	AHA
Non-Physician FTEs	Total number of non-physician FTEs for the hospital	AHA
Non-Labor Expenses	Total operating expenses minus payroll expenses expressed in 2008 dollars	AHA
Total Admissions	Number of admissions for the facility	AHA
Births	Number of live births in the facility	AHA
Total Surgical Procedures	Number of both inpatient and outpatient surgical procedures for the facility	AHA
Emergency Room/Department Visits	Number of outpatient visits to the ER/ED	AHA
Other Outpatient Visits	Number of non-ER/ED outpatient visits	AHA
<b><u>Independent Variables</u></b>		
Individual Measure of Fit / Congruence	Set of Indicator Variables (coded as 1 or 0) indicating which group the hospital belongs to based on the 2 x 2 matrix for that contingent pair	Calculated
Composite Measure of Fit/Congruence	Sum of the misfit scores for each hospital from the four contingent pairs	Calculated
<b><u>Variables Used to Calculate the Fit/Congruence Scores</u></b>		
Per Capita Income	Per capita income for the county where the hospital is located - for 2004	ARF
Unemployment Rate	Percentage of persons unemployed in 2004 for the county where the hospital is located	ARF
Proximity to Another Hospital	Dichotomous variable coded as 1 if the hospital is within 50 miles of another hospital, zero otherwise	Calculated using Longitude and Latitude from AHA

Table 3. Study Variables (continued)

Variable	Measurement	Data Source
<b><u>Variables Used to Calculate the Fit/Congruence Scores (continued)</u></b>		
Proximity to a Larger Hospital	Dichotomous variable coded as 1 if the hospital is within 50 miles of another hospital that has at least 50 more beds	Calculated using Longitude and Latitude from AHA
CAH Status	Indicator variable coded as 1 if the hospital is a CAH, otherwise zero	AHA
System Membership	Indicator variable coded as 1 if the hospital belongs to a system, otherwise zero	AHA
Local System Partner	Dichotomous variable coded 1 if there is another hospital that is part of the same system within 50 miles, otherwise zero	Calculated using Longitude and Latitude from AHA
Hierarchical System Partner	Dichotomous variable coded 1 if there is another larger hospital that is part of the same system within 50 miles, otherwise zero	Calculated using Longitude and Latitude from AHA
<b><u>Control Variables</u></b>		
Lagged Dependent Variable	The same dependent variables as listed above, but for 2002 to 2004	HCRIS / Calculated
Hospital Size	Number of staffed beds for the hospital - average for 2006 to 2008	AHA
Ownership Type	Dichotomous variable coded 1 if for-profit, otherwise zero	AHA
Teaching Status	Dichotomous variable coded 1 if the hospital runs a teaching program, otherwise zero	AHA
Medicare Payer %	Total facility inpatient days / Medicare inpatient days - average for 2006 to 2008	AHA
Medicaid Payer %	Total facility inpatient days / Medicaid inpatient days - average for 2006 to 2008	AHA
Per Capita Income	Per capita income for the county where the hospital is located - for 2006	ARF
Unemployment Rate	Percentage of persons unemployed in county - average for 2006 to 2007	ARF
US Census Division	Set of indicator variables for the 9 US Census divisions	ARF

### Analytic Methods

Analysis for this study consists of three phases: calculation of the DEA efficiency scores, descriptive statistics, and inferential testing using regression analysis.

Calculation of the DEA efficiency scores for each hospital will be performed using the Excel based DEA software developed by Joe Zhu (2009) for his book, Quantitative Models for Performance Evaluation and Benchmarking. The four input and five output variables identified for the model will be imported into the spreadsheet in the format specified by Zhu and then an efficiency score for each will be generated. This will be done for each year in the study period, and then the efficiency scores for 2002 to 2004 and the efficiency scores for 2006 to 2008 will be averaged together to create the lagged dependent control variable and the dependent efficiency variable respectively.

Next descriptive statistics will be calculated for all of the variables used in the analysis. The mean and standard deviation for each variable will be used to compare the study sample to the hospitals that were excluded from the study sample in order to identify any systematic differences between the groups. Additionally, comparisons will be made between the hospitals in the sample based on ownership status, system membership, CAH status, and geographic region. This preliminary analysis will provide information about a priori assumptions related to control variables and possible selection bias by for-profit systems as reported by Halpern et al. (1992).

Regression analysis will be used to test the hypothesized relationships in the study. Ordinary least squares (OLS) regression will be used for the models where financial

performance is the dependent variable, and in accordance with previous DEA analysis (Chilingerian, 1995) a Tobit regression model will be used where the transformed DEA efficiency score is the dependent variable. The empirical model is the same for each type of regression:

$$\bar{Y}_{i2006-2008} = \beta_0 + \beta_1 F_{i2004} + \beta_2 \bar{H}_{i2006-2008} + \beta_3 \bar{M}_{i2006-2008} + \beta_4 \bar{Y}_{i2002-2004} + \varepsilon_i \quad (1.1)$$

Where  $\bar{Y}_{i2006-2008}$  is the average dependent performance variable for hospital  $i$  in years 2006 through 2008,  $F_{i2004}$  is the fit/congruence score for hospital  $i$  in 2004,  $\bar{H}_{i2006-2008}$  is the set of control variables for hospital characteristics,  $\bar{M}_{i2006-2008}$  is the set of control variables for market characteristics,  $\bar{Y}_{i2002-2004}$  is the lagged performance measure, and  $\varepsilon_i$  is the error term. This analysis will be run ten different times, to test all 5 hypotheses for both dependent variables. For the analysis of the first four hypotheses,  $F_{i2004}$  represents the individual fit / congruence scores for the contingent relationships specified in the hypothesis. For testing the fifth hypothesis,  $F_{i2004}$  represents the composite fit/congruence score created by summing the “misfit” scores from all of the contingent pairs for each hospital.

#### Limitations of the Study Methods

There are three potential limitations to the proposed study methods. The first is the non-experimental design of the study and the lack of a baseline performance measure prior to each hospital becoming part of a multi-hospital system. Ideally, the study would use a quasi-experimental design with performance measures taken before and after rural hospitals joined multi-hospital systems, and the period when the hospitals joined systems

would be relatively short and well defined. However, in reality that is not the case. Rural hospitals joined multi-hospital systems over a period of several years (as much 30 years), with no clear beginning and no clear end. Over that period, the secondary data sources available for analysis changed as questions were added and removed from the AHA survey and the format for the HCRIS and ARF were modified over time. Even if the data were consistent and available, such a long study period would make it very difficult to control for the numerous significant environmental and legislative changes that have occurred. Thus while the study design is not ideal, it makes an acceptable tradeoff between data availability, statistical control, and the ability to make causal inferences.

The second limitation concerns measurement error associated with the self-reported data elements in the AHA survey used to classify the health systems. This issue has been raised by other authors (Mullner & Chung, 2002; Luke, 1996) and was addressed by Bazzoli et al. (2006). Their answer was simply that the AHA survey does have some measurement error as does any survey or empirical work. However, how much measurement error there may be in the AHA survey is not clear, and of greater consequence is the fact that the AHA survey has been used in a large number of hospital studies with great success. The most important concern when using the AHA annual survey, as with any survey, is to understand the data elements that are incorporated into the study and use them appropriately (Mullner & Chung, 2002).

The final limitation is one of potential selection bias / endogeneity, in that the choice of a hospital to join a particular health system may not be random. Hospitals with poor

financial performance or hospitals which need to downsize inpatient services may seek out a system partner that facilitates this. The possible consequence is that financial performance or inefficiency, both of which are the dependent variables in this study, could be the reason why rural hospitals join multi-hospital systems to begin with.

Although the statistical models employed in this study control for several hospital and market characteristics, they do not control for potential endogeneity. Instead, this potential problem is addressed through sample selection and preliminary analysis. The sample for this study contains essentially the entire population of U.S. non-federal rural acute care general hospitals, and descriptive analysis of variable means will indicate if system and non-system hospitals are systematically different from one another.

However, this study does not measure the relationship between system membership and hospital performance, but rather the relationship between “fit” and performance. For each hypothesis the hospitals in the “fit” and “misfit” categories are different, and both categories may contain system and non-system hospitals. Therefore the presence of a systematic relationship between system membership and performance is not as great of a concern as it would be if system membership was being directly linked to performance. Additionally, on a theoretical level, the concept of bounded rationality (March & Simon, 1993) indicates that hospital leaders may not always realize when their hospitals are in trouble, and even if they do they may not discern all of the strategic choices available to them (like joining a multi-hospital system). Thus there is potentially no clear underlying logic why some hospitals have joined systems and some have not.



### Summary of the Methods Chapter

This chapter described the methods for this study including the research design, the definition and source of all variables and the analysis methods used to test each hypothesis. Calculation of the DEA efficiency scores and the fit/congruence scores for each hospital were discussed in detail, and limitations of the study methods were presented. The next chapter will present the results of the analysis in detail.

## CHAPTER 5 – RESULTS

This chapter discusses the preparation of the study data set for analysis and presents the results of the analysis. The first section discusses how the two dependent variables and the fit/congruence scores for the study were calculated and presents some descriptive statistics for these variables. The second section reports descriptive statistics for the study sample and also compares the study sample to hospitals that were excluded from the study sample due to estimated AHA data or a change in system and/or CAH status. The third section presents the results of the regression analysis used to test the study hypotheses, and the fourth section presents a supplementary analysis that was performed with the hospitals that were excluded from the study sample as well as a simple test of the equal weights assumption used to calculate the composite fit measure for each hospital. The chapter closes with a summary of the results.

### Data Preparation and Calculation of Study Measures

As discussed in the methods chapter, the data set for the study was constructed by merging data from the AHA annual hospital survey, the ARF data set, and the CMS HCRIS files. Although the study period is from 2004 to 2008, AHA and HCRIS data from 2002 and 2003 were also used in order to construct the lagged dependent variables, which are three year averages. The AHA data were merged with the ARF data using the Federal Information Processing Standard (FIPS) codes for the state and the county in

which the hospital was located. Then the HCRIS data were merged with the AHA and ARF data using the hospital Medicare identification number.

In addition to merging data from different sources together, several AHA variables were re-coded into dichotomous variables or converted into a set of dummy variables for the analysis, and the two dependent variables and the fit/congruence scores were calculated. The following sub-sections discuss the calculation of each of the dependent variables and the hospital fit scores and reports some summary statistics for these variables.

#### *Calculation of the Hospital Efficiency Scores*

DEA scores were calculated for the 1,421 short-term, acute care, general rural hospitals that were in the sampling frame (1,010 hospitals in the sample, 235 hospitals with estimated AHA data, 96 hospitals that changed system status within the study period, and 80 hospitals that changed CAH status during the study period). These scores were then used in the analysis of the study hypotheses as well as the supplementary analysis that examined the effect of including the hospitals with AHA estimated data and the comparisons of the study sample to the hospitals that were excluded due to a change in system or CAH status.

DEA scores were calculated for each hospital for the years 2002 to 2008, and then the scores were averaged together for 2002 to 2004 to create the lagged dependent variable, and for 2006 to 2008 to create the dependent variable. The most efficient hospitals within the sample have a score of “1” and the other less efficient DMUs within

the sample have an efficiency score between “0” and less than “1”. However, the DEA scores are essentially censored variables Chilingierian (1995), which need to be transformed in order to meet the distributional assumptions for regression analysis. Following Chilingierian’s example, the DEA efficiency scores were transformed using the equation  $(1/\text{DEA Score})-1$ , and were analyzed using a Tobit model, which is a regression model for dependent variables that are censored at zero but are roughly continuously distributed over strictly positive values (Wooldridge, 2009). Therefore the dependent variable for the efficiency analysis is an inefficiency score, where efficient hospitals have a score of “0” and a higher score represents greater inefficiency. Table 4 summarizes the hospital DEA efficiency scores and the converted inefficiency scores for each year.

Table 4. Summary of DEA Efficiency Scores

	DEA Efficiency Scores							Average Efficiency		Average Inefficiency	
	2002	2003	2004	2005	2006	2007	2008	02 to 04	06 to 08	02 to 04	06 to 08
<b>Mean</b>	0.591	0.502	0.593	0.566	0.576	0.567	0.589	0.562	0.577	1.086	1.029
<b>Std Dev</b>	0.213	0.202	0.208	0.214	0.204	0.212	0.211	0.193	0.198	1.034	1.099
<b>Minimum</b>	0.091	0.082	0.083	0.076	0.077	0.022	0.038	0.110	0.052	0	0
<b>Maximum</b>	1	1	1	1	1	1	1	1	1	8.09	18.31
<b>Efficient Hospitals</b>	80	36	65	52	56	67	74	18	24	18	24

The DEA summary scores reveal that for the period 2002 to 2008, 2003 was the worst year in terms of hospital efficiency Scores with a mean efficiency score of 0.502 for the group and only 36 hospitals receiving the maximum efficiency score of 1. Other than 2003, the mean efficiency scores for each year are very similar with between 3.7% and 5.6% of hospitals in each year being rated as efficient. Looking at the average efficiency

scores, the mean for the 2006 to 2008 period is slightly higher than the 2002 to 2004 period, but this difference is not statistically significant and is largely determined by the 2003 efficiency mean. Eighteen hospitals in the 2002 to 2004 period and 24 hospitals for the 2006 to 2008 period were efficient (a score of 1) for all three years, indicating that some hospitals in the sample consistently perform at a high level in terms of efficiency. The average inefficiency scores reverse the scale and identify the efficient hospitals with a 0 instead of 1, and the inefficient hospitals are now identified by a high score rather than a low score. However, unlike the efficiency scores which must be between 1 and 0, the inefficiency scores can assume any positive number, resulting in a greater range of scores.

#### *Calculation of Average Hospital Total Margin*

The intent for calculating the average total margin for each hospital was very similar to the calculation of the efficiency scores. Using the HCRIS data, total margin would be calculated for each hospital for the years 2002 to 2008 and then the values for 2002 to 2004 and the values for 2006 to 2008 would be averaged together to produce the lagged dependent and dependent variables, respectively. However, this task proved to be much more difficult than originally conceived. Several problems with the HCRIS data had to be addressed in order to calculate the three-year averages needed for the study.

The first problem was that the HCRIS data are reported in fiscal years rather than calendar years, making it difficult to determine what HCRIS reports should be matched with each calendar year for a given hospital. The second problem (which compounds the

first problem) is that several hospitals changed their fiscal year during the study period, causing the length of the time period for their HCRIS reports to vary across the study period. Some of the reports were very short (as little as one quarter) and some were very long (over 400 days), and matching these reports to a specific calendar year was very difficult. Reports which contained less than 270 days were excluded because it was feared that they represented periods that contained some unusual event requiring a partial year report. Finally, there was also a problem with missing data or non-reported values for a given hospital, which are generally reflected as zeros in the CMS cost reports. The missing data were a combination of non-reported values or the absence of the reports that were less than 270 days.

To deal with these problems and still retain as many hospitals as possible in the study sample, total margin averages for each hospital were calculated using the fixed effect for time for each hospital obtained from a longitudinal regression of total margin on dummy variables for each year. This is in essence a method of imputation; however, this method has the added advantage of controlling the aberrant influence of a given year (i.e. the possibility that the data that are present is the product of a potentially “good” or “bad” year and simply taking a 2-year average when one year of data are missing would produce an average that is overly influenced by the aberrant year). A second advantage is the elimination of the need to match HCRIS fiscal years to calendar years. The year dummy variables used in the longitudinal regression were calculated based on the proportion of the HCRIS report days that fell within a given calendar year.

The first step in the procedure was to assemble all of the HCRIS data into a panel data set. The observations for each hospital from 2002 to 2008 were put into one data set, with the AHA hospital identification number identifying the panels and the HCRIS report year identifying the time periods within a given panel. The panel data set was then divided into two data sets with the reports that ended on or before 30 June 2005 in the data set that would be used to calculate the 2002 to 2004 average total margin and reports that began on 1 July 2005 or later in the data set that would be used to calculate the 2006 to 2008 average total margin.

Next the dummy variables for each year were calculated. If all of the HCRIS reports started on 1 Jan and ended on 31 December, then the yearly dummy variables would all equal one. However, that is not the case. For any given hospital, the fiscal year for the HCRIS reports could or could not match the calendar year. If the fiscal year matched the calendar year, then the year dummy for that hospital for that year was equal to one. If the fiscal year did not match the calendar year, then the year dummy reflected the number of days from the HCRIS report that fell into that calendar year (i.e. if the HCRIS report was from 1 Oct 2002 to 30 Sep 2003 then the year dummy for 2002 would be .25 and the year dummy for 2003 would be .75 for that hospital for that report). By doing this, the year dummies reflected the proportion of each report that fell into each calendar year, essentially matching the reports to the calendar years.

After calculating the year dummy variables, a fixed effects model was used to isolate hospital fixed effects for time. This was done by regressing the yearly dummy variables

upon hospital total margin (equation 1.2 for the 2002 to 2004 average and equation 1.3 for the 2006 to 2008 average) to isolate the hospital fixed effect ( $a_i$ ) and the estimated coefficients for the influence of each year ( $\beta_1$  &  $\beta_2$ ).

$$Y_{it} = a_i + \beta_1 D_{2003} + \beta_2 D_{2004} + \varepsilon_i \quad (1.2)$$

$$Y_{it} = a_i + \beta_1 D_{2007} + \beta_2 D_{2008} + \varepsilon_i \quad (1.3)$$

The fixed effect for each hospital was then added to the sample mean total margin to generate the three-year average total margin for each hospital. When all three years of data are present for a given hospital, then the average generated by this procedure is equivalent to the actual average for the three years. But when one year of data is missing, this procedure produces a three-year average that is different from the average of the two years of data that is present, because it controls for time effects (i.e., the year dummy coefficients). To illustrate the benefit of this technique, consider an example hospital which has a fixed effect of 0.10; in other words the hospital's total margin exceeds the mean total margin of the sample by .10. Suppose that the mean margins for the sample in the three years were -0.05, 0.0, and 0.05 (so the example hospital's margins were 0.05, .0.10, and 0.15). If the first year of data for the example hospital were missing, then its mean margin would be 0.075; if the third year were missing then its mean margin would be 0.125. But with calculation of average margin based on estimating fixed effects, the average margin for this hospital is 0.10 no matter which of the data values is missing.

A summary of the calculated three-year total margin average is presented in Table 5.

Note that hospitals that were missing more than one year of data for a given three-year



Table 5. Summary of Average Total Margin

	Mean	Std. Dev.	Min	Max
Average Total Margin 2002-2004	0.0158	0.1757	-3.7585	1.7533
Average Total Margin 2006-2008	0.0268	0.0751	-0.3949	0.5437

period were excluded from the analysis. This exclusion results in the slightly different sample sizes for the analysis of the two dependent variables (n=1010 for efficiency and n=1007 for total margin). The average total margin mean in both periods was positive, and although both mean values are relatively small; the mean for 2006 to 2008 is nearly twice the mean for 2002 to 2004. Additionally, the standard deviation of the mean for the 2006 to 2008 period is much smaller than the 2002 to 2004 period, indicating that there is less dispersion in the hospital average total margin values for the later period.

#### *Calculation of the Fit/Congruence Scores*

The calculation of the fit/congruence scores for the study occurred in two steps. First, the individual measures used to construct the fit/congruence scores had to be calculated. This included the generation of a single resource munificence measure, the identification of hospitals that were proximate to other hospitals, and the identification of proximate and hierarchical system partners. The second step was combining the measures for the four contingent pairs identified in the conceptual framework, and assigning the hospitals to a group based on the 2x2 matrices discussed in the study methods. The following paragraphs discuss the generation of the variables required to assess fit/congruence and then report summary statistics for these variables. Then the 2x2 matrices for the individual fit/congruence scores are shown with the number of

hospitals falling into each category, and the section closes with a summary of the composite fit/congruence scores.

The resource munificence measure was generated using the principle component method of factor analysis on the variables per capita income and unemployment rate from the ARF data set. A single factor was extracted that retained 69.7% of the total variance of the two variables, and the factor loadings were used to generate a new variable which was named resource munificence. Percentiles for this new variable were then calculated, and hospitals which were below the 25<sup>th</sup> percentile were classified as “low resource munificence” and hospitals that were above the 75<sup>th</sup> percentile were classified as “high resource munificence”. Table 6 contains the results of the factor analysis, summary statistics for the new resource munificence variable, and a count of how many hospitals fall into the different resource munificence categories.

The top portion of Table 6 shows the results of the factor analysis on the left and the factor loadings that were used to construct the new resource munificence variable. In the center of Table 6 are the summary statistics for the new resource munificence variable and the percentile scores that were used to identify the high, medium-high, medium-low, and low resource area hospital groups. At the bottom of the table is a count of the hospitals in each group. Hospitals in the low munificence group and hospitals in the high munificence group were then combined with a dichotomous measure of system membership to calculate the fit/congruence measure for the first hypothesis. The 2x2 matrices showing how many hospitals fall into each group are at the end of this section.

Table 6. Summary of the Creation of the Resource Munificence Measure

Factor Analysis of Per Capita Income and Unemployment Rate					Component Matrix	
Factor	Eigenvalue	Difference	Proportion	Cumulative	Component 1	
Factor1	1.395	0.790	0.698	0.698	percapincome2004	0.835
Factor2	0.605	.	0.303	1.000	unemployrate2004	-0.835

LR test: independent vs. saturated:  $\chi^2(1) = 240.89$  Prob> $\chi^2 = 0.000$  Extraction Method: Principal Component Analysis.

Summary statistics for the new variable: Resource Munificence				
Percentiles	Smallest	Largest	Obs	1421
1%	-2.492	-4.651	Mean	0.004
5%	-1.541	-4.486	Std. Dev.	0.991
10%	-1.126	-4.421	Variance	0.983
25%	-0.605	-3.925	Skewness	0.151
50%	-0.005		Kurtosis	7.034
75%	0.658	3.226		
90%	1.153	4.339		
95%	1.465	4.504		
99%	2.459	7.795		

Count of Hospitals in Each Munificence Quartile	
Low Resource Munificence (below 25th percentile)	253
Medium-Low Resource Munificence (25th to 50th percentile)	246
Medium-High Resource Munificence (50th to 75th percentile)	255
High Resource Munificence (above 75th percentile)	256

The next variables that were generated were the hospital proximity measures that counted the number of other hospitals, other system hospitals, larger hospitals, and larger system hospitals that were within 50 miles of a given hospital. The “circnum” command in Stata, which calculates straight line distance between observations based on the latitude and longitude for each observation, was used to perform this operation. As discussed in the methods section, a radius of 50 miles was used for the proximity measures in this study. However, there is no consensus in the existing literature on how

close system hospitals need to be in order to centralize administrative, logistic, and/or clinical services. In fact centralization of administrative services may not require system hospitals to be proximate to one another, and the degree of proximity required to centralize logistic services may be different than that required for clinical services. For this reason, the proximity measures were also calculated using a radius of 35 miles, and the fit/congruence measures for hypotheses 2 through 5 were calculated using both the 50 mile radius and the 35 mile radius, and then the raw scores were converted to indicator variables in order to calculate the fit/congruence scores. The scores calculated using a 35 mile radius will be used in a supplementary analysis to determine if the distance on which the proximity measures are based affects the study results. A summary of the proximity measure raw scores and the indicator variables is presented in Table 7. The proximity scores reveal that 98% are within 50 miles of at least one other hospital, and on average a rural hospital is within 50 miles of 11 other short-term acute care hospitals. However, only 28% of the hospitals are within 50 miles of a hospital that is within the same system, and only 16% of the hospitals are within 50 miles of a larger system hospital. As expected, these numbers are lower for the 35 mile radius measures, with the greatest difference in the large proximate hospital measure.

The fit/congruence scores for hypotheses one through four were calculated by combining the resource munificence, system membership, proximity measure, and CAH status variables in accordance with the 2x2 matrices discussed in the study methods. Based on the 50 mile radius proximity measures, the number of hospitals falling into each

Table 7. Summary of the Calculated Proximity Measures

Variable	Summary Statistics for Actual Values				Summary of Indicator Variables	
	Mean	Std. Dev.	Min	Max	Mean	Number = 1
Number of Proximate Hospitals 50 miles	11.52	7.11	0	47	0.98	989
Number of Proximate Hospitals 35 miles	5.05	3.40	0	20	0.92	932
Number of Local System Partners 50 miles	0.69	1.37	0	9	0.28	287
Number of Local System Partners 35 miles	0.36	0.83	0	7	0.21	212
Large Proximate Hospitals 50 miles	4.12	4.39	0	28	0.81	818
Number of Large Proximate Hospitals 35 miles	1.62	1.99	0	12	0.60	607
Number of Hierarchical System Partners 50 miles	0.24	0.65	0	6	0.16	161
Number of Hierarchical System Partners 30 miles	0.13	0.41	0	3	0.10	104

group for each hypothesis is shown in Figure 10. For the first hypothesis only the hospitals in the lowest and highest munificence quartiles are used in the analysis, so the

H1: Resource Munificence / System Membership 2 x 2

Resource Munificence	High	154	102
	Low	157	96
		No	Yes
		System Membership	

H3: Proximity to Larger Hospital / Hierarchy 2 x 2\*

Proximity to Larger Hospital	Yes	657	161
	No	192	N/A
		No	Yes
		Hierarchy	

H2: Proximity to Other Hospital / Local Partner 2 x 2\*

Proximity to Other Hospital	Yes	702	287
	No	21	N/A
		No	Yes
		Local Partner	

H4: CAH Status / Hierarchy 2 x 2\*

CAH Status	Yes	463	87
	No	386	74
		No	Yes
		Hierarchy	

\*The numbers in these matrices reflect the 50 mile radius proximity measures

Figure 10 – Number of Hospitals in Each Fit/Congruence Group

numbers in the matrix do not add up to 1010. The other three hypotheses use the entire study sample, and the numbers in each matrix add up to n=1010.

The composite fit/congruence score was calculated by adding the number of times a hospital fell into the “misfit” category for one of the four individual fit/congruence measures. The misfit categories or groups are indicated by the shaded boxes in Figure 10, and Table 8 shows the number and percent of sample hospitals receiving each composite fit/congruence score. These scores reveal that over 82% of the hospitals in the study sample fell into the misfit category for at least one of the individual fit/congruence score measures and more than 68% were a misfit in two or more measures.

Table 8. Summary of Composite Fit Scores

Score	Description	# of Hospitals	% of Hospitals
0	Hospital was not a misfit in any individual measure	180	17.82%
1	Hospital was a misfit in one individual measures	141	13.96%
2	Hospital was a misfit in two individual measures	294	29.11%
3	Hospital was a misfit in three individual measures	330	32.67%
4	Hospital was a misfit in four individual measures	65	6.44%

### Descriptive Statistics and Analysis

Descriptive statistics for each of the variables in the regression models are presented in this section for both the study sample and the hospitals that were excluded from the sample due to estimation of AHA measures and changes in CAH and system status. Study sample variable values are compared to the values for the other groups in order to detect potential mortality threats, and gather information about how the exclusion of these hospitals may affect the study results. Correlation analysis of the independent

variables in the regression models that is used to ensure that the assumption of no perfect collinearity holds for the regression analysis is presented at the end of this section.

### *Descriptive Statistics*

Descriptive statistics for the study sample as well as the hospitals that were excluded due to AHA estimated values and changing system and CAH status are reported in Table 9. The study sample consists of n=1010 short-term acute care general hospitals located in either micropolitan (37.3%) or non-core (62.7%) statistical areas. Slightly more than half (53.9%) are privately owned not-for-profit hospitals, 40.5% of them are owned by a multi-hospital system, and less than two percent have a GME residency program. Although the sample contains hospitals from every census division, the majority of sample hospitals are either in the West North Central (27.2%), the West South Central (17.1%), or the East North Central (15.3%) divisions. Sample hospitals have on average 59.72 staffed beds and receive over 70% of their payments from either Medicare (50%) or Medicaid (21.7%), and both their average productive efficiency and total margin increased from the 2002-2004 period to the 2006-2008 period.

Compared to the hospitals that were excluded from the study sample, there are some statistically significant differences that are worth noting. First, hospitals that changed system status during the study period were more likely to belong to a multi-hospital system than the hospitals in the study sample. This is understandable since the majority of hospitals that changed system status during the study period (47 out of 80) went from being independent to being part of a system. Second, hospitals with AHA estimated

Table 9. Descriptive Statistics for Study Variables

Proportional Variables	Hospitals in Study Sample (n=1010)		Hospitals that changed System Status (n=80)		Hospitals that changed CAH Status (n=96)		Hospitals with AHA Estimated Values (n=235)	
	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion
<b>Fit/Congruence Groups</b>								
Hypothesis 1								
Low Munificence - No System	157	15.54%	10	12.50%	8	8.34%*	32	13.62%
Low Munificence - System	96	9.50%	13	16.25%*	10	10.42%	29	12.34%
High Munificence - No System	154	15.25%	12	15.00%	11	11.46%	38	16.17%
High Munificence - System	102	10.10%	8	10.00%	14	14.58%	17	7.23%
Hypothesis 2								
No Proximate Hosp - No Local Partner	21	2.08%	3	3.75%	0	0.00%	8	3.40%
Proximate Hosp - No Local Partner	702	69.50%	62	77.50%	67	69.79%	163	69.36%
Proximate Hosp - Local Partner	287	28.42%	15	18.75%*	29	30.21%	64	27.23%
Hypothesis 3								
No Proximate Large Hospital	192	19.01%	13	16.25%	18	18.75%	41	17.45%
Proximate Large Hosp - No Hierarchical Partner	657	65.05%	64	80.00%**	60	62.50%	154	65.53%
Proximate Large Hosp - Hierarchical Partner	161	15.94%	3	3.75%**	18	18.75%	40	17.02%
Hypothesis 4								
Non-CAH - No Hierarchical Partner	386	38.22%	42	52.50%**	77	80.21%**	84	35.74%
Non-CAH - Hierarchical Partner	74	7.33%	2	2.50%	17	17.71%**	25	10.64%*
CAH - No Hierarchical Partner	463	45.84%	35	43.75%	1	1.04%**	111	47.23%
CAH - Hierarchical Partner	87	8.61%	1	1.25%**	1	1.04%**	15	6.38%
Hypothesis 5								
Misfit in Zero Fit Measures	180	17.82%	7	8.75%**	22	22.92%	44	18.72%
Misfit in One Fit Measure	141	13.96%	8	10.00%	18	18.75%	25	10.64%
Misfit in Two Fit Measures	294	29.11%	34	42.50%**	50	52.08%**	80	34.04%
Misfit in Three Fit Measures	330	32.67%	29	36.25%	6	6.25%**	69	29.36%
Misfit in Four Fit Measures	65	6.44%	2	2.50%	0	0.00%**	17	7.23%
<b>Other Indicator Variables</b>								
CBSA Type								
Micropolitan Area	377	37.33%	30	37.50%	28	29.17%	78	33.19%
Non-Core Area	633	62.67%	50	62.50%	68	70.83%	157	66.81%
System Membership								
Non-System	601	59.50%	33	41.25%**	52	54.17%	135	57.45%
System	409	40.50%	47	58.75%**	44	45.83%	100	42.55%
Ownership Status								
For Profit	74	7.33%	9	11.25%	0	0.00%**	36	15.32%**
Not For Profit	545	53.96%	45	56.25%	58	60.42%	109	46.38%**
Local Government	391	38.71%	26	32.50%	38	39.58%	90	38.30%
Teaching								
GME Residency	17	1.68%	0	0.00%	0	0.00%	2	0.85%
No GME Residency	993	98.32%	80	100.00%	96	100.00%	233	99.15%
Census Divisions								
New England	31	3.07%	3	3.75%	6	6.25%*	6	2.55%
Middle Atlantic	39	3.86%	3	3.75%	2	2.08%	7	2.98%
East North Central	154	15.25%	5	6.25%**	16	16.67%	32	13.62%
West North Central	275	27.23%	9	11.25%**	39	40.63%**	41	17.45%**
South Atlantic	95	9.41%	16	20.00%**	1	1.04%**	28	11.91%
East South Central	92	9.11%	14	17.50%**	5	5.21%	41	17.45%**
West South Central	173	17.13%	16	20.00%	12	12.50%	30	12.77%
Mountain	100	9.90%	12	15.00%	8	8.33%	26	11.06%
Pacific	51	5.05%	2	2.50%	7	7.29%	24	10.21%**
Resource Munificence Quartiles								
Low	253	25.05%	23	28.75%	18	18.75%	61	25.96%
Medium-Low	246	24.36%	22	27.50%	23	23.96%	64	27.23%
Medium-High	255	25.25%	15	18.75%	30	31.25%	55	23.40%
High	256	25.35%	20	25.00%	25	26.04%	55	23.40%

\* Group proportion is significantly different from the study sample at the  $p < .10$  level

\*\* Group proportion is significantly different from the study sample at the  $p < .05$  level



Table 9. Descriptive Statistics for Study Variables (continued)

Continuous Variables	Hospitals in Study Sample (n=1010)		Hospitals that changed System Status (n=80)		Hospitals that changed CAH Status (n=96)		Hospitals with AHA Estimated Values (n=235)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
<b>Control Variables</b>								
Resource Munificence	0.003	1.005	0.003	1.205	0.113	0.788	-0.038	0.926
Staffed Beds (06-08 avg)	59.720	50.519	57.408	45.036	42.160	30.886**	61.043	48.219
Medicaid Payer % (06-08 avg)	0.217	0.199	0.197	0.186	0.197	0.187	0.221	0.169
Medicare Payer % (06-08 avg)	0.500	0.230	0.553	0.212**	0.513	0.224	0.483	0.177
Unemployment Rate (06-07 avg)	4.999	1.772	5.109	1.890	4.947	1.424	4.969	1.682
Per Capita Income - 2006	\$27,168	5148.275	\$28,300	7036.835*	\$27,257	3442.024	\$27,114	5635.245
<b>Efficiency Measures</b>								
Hospital Efficiency (02-04 avg)	0.557	0.196	0.585	0.164	0.557	0.162	0.577	0.201
Hospital Inefficiency (02-04 avg)	1.124	1.092	0.938	0.973*	0.981	0.696*	1.013	0.898*
Hospital Efficiency (06-08 avg)	0.571	0.197	0.590	0.184	0.610	0.195*	0.588	0.206
Hospital Inefficiency (06-08 avg)	1.057	1.141	0.989	1.227	0.836	0.669**	1.000	1.000
<b>Financial Measures</b>								
	(n=1007)		(n=79)		(n=95)		(n=235)	
Hospital Total Margin (02-04 avg)	0.016	0.176	0.004	0.073	0.023	0.068	0.021	0.070
Hospital Total Margin (06-08 avg)	0.027	0.075	0.015	0.066*	-0.036	0.758**	0.024	0.078

\* Group mean is significantly different from the study sample at the  $p < .10$  level

\*\* Group mean is significantly different from the study sample at the  $p < .05$  level

values are twice as likely to be for-profit than study sample hospitals, indicating that for-profit hospitals may be more likely to not complete the AHA annual survey. Third, hospitals that changed system status were more likely to be in the South Atlantic or East South Central census divisions and hospitals that changed CAH status were more likely to be in the West North Central census division than study sample hospitals. This may indicate that multi-hospital systems are more actively buying and selling hospitals in the South Atlantic and East South Central areas and hospitals in the West North Central census division are some of the last small rural hospitals to convert to CAH status. Hospitals that changed CAH status were on average significantly smaller (42.16 staffed beds) than study sample hospitals, but this is not surprising since smaller hospitals are more likely to convert to CAH status. The most significant differences between study sample hospitals and the hospitals that were excluded from the study sample are differences in hospital efficiency and total margin. Hospitals that changed CAH status

during the study period improved their efficiency during the study period and were significantly more efficient than study sample hospitals at the end of the study period, but on average had lower total margins than study sample hospitals at the end of the study period. Although it cannot be determined using the data in this study, the difference in total margin may be related to the costs of converting to CAH status, and the difference in hospital efficiency may reflect initial staff down-sizing and/or service cuts which may happen when a hospital converts to CAH status. However, these differences are unexpected and contradict previous studies which have shown CAHs to be less efficient than comparable rural hospitals (Rosko & Mutter, 2010; Harrison et al., 2009).

#### *Correlation Analysis*

One of the primary assumptions of multiple regression analysis is that there are no exact linear relationships or perfect collinearity among the independent variables (Wooldridge, 2009, pg 85). A correlation analysis of all of the independent variables was conducted to ensure that no two independent or control variables are perfectly correlated, as a violation of this assumption would not produce any coefficient estimates.

Additionally, the correlations were examined to determine if any of the variables were highly correlated, often referred to as multi-collinearity. Although high correlations among variables do not violate the perfect collinearity assumption, it is preferred to have less correlation among independent variables (Wooldridge, 2009, pg 98).

The correlation matrix for the variables included in the regression analysis is shown in Appendix 1. No two variables are perfectly collinear and the only large correlation

(over +/- .70) between independent variables is the correlation between Medicare payer percentage and Medicaid payer percentage (-0.79). Since this correlation is less than one, the Gauss-Markov assumption of no perfect collinearity required to establish the unbiasedness of the OLS estimates is not violated. However, a large correlation between two independent variables increases the variance of the estimated coefficients for these variables. But Medicare and Medicaid payer percentage are simply control variables in this analysis and their coefficients are not germane to the hypotheses tested in this study.

#### Evaluating the Theoretical Hypotheses

The five hypotheses for the study were evaluated using multiple regression analysis for the financial dependent variable and Tobit regression for the dependent efficiency score. Because the sample size is sufficiently large, all of the regression models were estimated with robust standard errors so the standard errors and t statistics associated with the estimated coefficients are valid for hypothesis testing even if heteroskedasticity of unknown form is present. The results for each hypothesis are presented in a single table that contains both the OLS and Tobit regression estimates for the two dependent variables. For each hypothesis, hospitals were divided into groups based on the 2x2 matrices discussed in the methods section and shown in Figure 8. The groups of hospitals used in each hypothesis are described beside each matrix and the group that is used as the reference category in the analysis is indicated. Below the description of the groups is a simple statement of each hypothesis indicating which groups are being compared during hypothesis testing. For the convenience of the reader, the reference

group and the groups being compared will be stated when the results for each hypothesis are presented.

For hypotheses one through four, a positive group coefficient for the dependent variable total margin indicates higher performance (i.e., higher total margin) and a negative coefficient for hospital inefficiency indicates higher performance (i.e., decreased inefficiency). The opposite is true for hypothesis five because the composite fit/congruence score sums the number of times a hospital is a “misfit” for each of the four individual fit/congruence measures. Thus a higher composite fit/congruence score indicates a poorer fit between environment and organization structure. Coefficients with a p-value less than .10, .05 and/or .01 are noted as statistically significant, and the level of significance is indicated in each table. Results which are in the predicted direction with a statistical significance level less than .05 are considered as support for the stated hypotheses. Results for each hypothesis will be presented and then general statements at the end of this section summarize the results from all five hypotheses.

#### *Hypothesis 1 Results*

Hypothesis one posited that in low resource munificence areas, hospitals that were part of a system would fit their environment better and outperform hospitals that remained independent. The reference group for this hypothesis is non-system hospitals in low resource areas. The hypothesis predicts that system hospitals in low resource areas will outperform non-system hospitals in low resource areas. Neither the results for hospital total margin nor hospital inefficiency provide support for this hypothesis, since

the p-values associated with both coefficients is greater than the .05 alpha level used for this study (results shown in Table 10). However, it is worth noting that even though the coefficients for the comparison group in both of the models were not statistically significant, the sign of the coefficients was consistent with the predicted relationship in hypothesis one. Further, the regression results for hospital total margin which indicated that the total margin for system hospitals in low resource areas is .017 higher than the total margin for non-system hospitals in low resource areas ( $p = .074$ ), came close to meeting the .05 alpha level for statistical significance. The same cannot be said for the Tobit model results using hospital inefficiency as the dependent variable.

Additional significant findings from the models are that not-for-profit hospitals have lower total margins than hospitals owned by local government entities ( $p = .075$ ), hospitals in the South Atlantic ( $p = .038$ ) and West South Central ( $p = .055$ ) census divisions have lower total margins than hospitals in the Pacific division, for-profit hospitals are more efficient than hospitals owned by local government entities ( $p = .036$ ), and hospitals with a higher percentage of Medicaid patients are less efficient ( $p = .052$ ). As expected, the lagged dependent variables are significantly related to the dependent variables in both equations. The results for ownership status, geographic location, Medicaid payer percentage, and the lagged dependent variables are significant for all of the regression models and will not be discussed for the remaining hypotheses.

Table 10. Regression Results for Hypothesis One

Dependent Variable	Total Margin (06-08 avg)		Inefficiency (06-08 avg)	
	Coef.	Robust	Coef.	Robust
		Std. Err.		Std. Err.
Low Munificence, System Hospital	0.017 *	0.009	-0.064	0.049
High Munificence, Non-System Hospital	-0.004	0.009	0.073	0.085
High Munificence, System Hospital	0.002	0.010	0.061	0.070
Lagged Dependent Variable (02-04 avg)	0.076 *	0.042	0.783 ***	0.085
Staffed Beds (06-08 avg)	4.0E-05	0.000	-3.9E-04	0.000
For Profit	-0.005	0.014	-0.173 **	0.082
Not For Profit	-0.009 *	0.005	-0.035	0.047
Teaching	-0.012	0.012	-0.099	0.099
Medicaid Payer % (06-08 avg)	0.013	0.023	0.807 *	0.415
Medicare Payer % (06-08 avg)	0.023	0.019	0.375	0.300
Per Capita Income 06	5.3E-07	0.000	3.2E-07	0.000
Unemployment Rate (06-07 avg)	-0.003	0.002	0.002	0.017
Middle Atlantic	-0.005	0.011	-0.054	0.081
East North Central	0.006	0.011	0.041	0.068
West North Central	-0.005	0.010	0.057	0.087
South Atlantic	-0.023 **	0.011	-0.037	0.073
East South Central	0.001	0.013	0.230	0.170
West South Central	-0.022 *	0.011	0.057	0.078
Mountain	0.014	0.011	0.072	0.100
Pacific	0.002	0.011	-0.037	0.112
Intercept	0.018	0.023	-0.223	0.263
	Number of obs = 1007		number of obs = 1010	
	F( 20, 986) = 2.52		F( 20, 990) = 41.27	
	Prob > F = 0.0002		Prob > F = 0.0000	

\* p &lt; .10

\*\* p &lt; .05

\*\*\* p &lt; .01

### *Hypothesis 2 Results*

The second contingent pair on which hypothesis two is based, relates the proximity to other hospitals with the presence or absence of a local system partner. Hypothesis two predicts that hospitals that are proximate to other hospitals will perform better if they

have a local system partner with which they can centralize administrative and/or logistic functions. In this model, hospitals that are proximate to other hospitals but have no local system partner are the reference group and the hypothesis predicts that hospitals with a local system partner(s), will outperform those without a local system partner. The results from both models (Table 11) support this prediction.

Table 11. Regression Results for Hypothesis Two

Dependent Variable	Total Margin (06-08 avg)		Inefficiency (06-08 avg)	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
No Hospital within 50 Miles	-0.012	0.023	0.109	0.249
System Partner within 50 Miles	0.012 **	0.006	-0.083 **	0.033
Lagged Dependent Variable (02-04 avg)	0.076 *	0.042	0.783 ***	0.084
Staffed Beds (06-08 avg)	4.3E-05	0.000	-4.2E-04	0.000
For Profit	-0.004	0.014	-0.172 **	0.081
Not For Profit	-0.010 **	0.005	-0.018	0.048
Teaching	-0.011	0.012	-0.102	0.101
Medicaid Payer % (06-08 avg)	0.012	0.023	0.806 *	0.419
Medicare Payer % (06-08 avg)	0.023	0.019	0.373	0.301
Per Capita Income 06	4.2E-07	0.000	2.8E-06	0.000
Unemployment Rate (06-07 avg)	-0.002	0.002	-0.007	0.016
Middle Atlantic	-0.004	0.011	-0.078	0.067
East North Central	0.003	0.010	0.047	0.062
West North Central	-0.006	0.010	0.076	0.081
South Atlantic	-0.024 **	0.011	-0.032	0.069
East South Central	2.1E-04	0.013	0.240	0.177
West South Central	-0.022 *	0.011	0.053	0.070
Mountain	0.017	0.011	0.046	0.090
Pacific	0.004	0.011	-0.052	0.110
Intercept	0.014	0.023	-0.220	0.266
	Number of obs = 1007		Number of obs = 1010	
	F( 19, 987) = 2.68		F( 19, 991) = 46.74	
	Prob > F = 0.0001		Prob > F = 0.0000	

\* p < .10

\*\* p < .05

\*\*\* p < .01

Other things constant, rural hospitals with local system partners in a 50 mile radius have a total margin that is 0.012 higher ( $p = .044$ ) and an inefficiency score that is 0.083 lower ( $p = .013$ ) than hospitals in the reference group.

### *Hypothesis 3 Results*

Hypothesis three focused on hierarchical system structures. Hierarchical system structures are necessary for the centralization of clinical services, and hypothesis three predicts that when rural hospitals are close to larger, predominantly urban hospitals, rural hospitals that have a hierarchical system partner will outperform rural hospitals that have no hierarchical partner. The reference group for this analysis was rural hospitals that are proximate to large hospitals but have no hierarchical partner, and the comparison group is rural hospitals with a proximate hierarchical partner. The results for the two models used to test hypothesis three are shown in Table 12. Similar to hypotheses four and five, the results for the OLS model using hospital total margin provide support for the hypothesis while the results for the Tobit model using hospital inefficiency do not. Other things equal, hospitals with a hierarchical partner have a total margin that is 0.021 higher ( $p = .009$ ) than hospitals that are proximate to a larger hospital but have no hierarchical partner. There is no significant difference between the three groups of hospitals in terms of hospital inefficiency.

### *Hypothesis 4 Results*

Hypothesis four continued to examine the potential performance benefit of having a proximate hierarchical system partner by focusing on rural hospitals certified as CAHs.



Table 12. Regression Results for Hypothesis Three

Dependent Variable	Total Margin (06-08 avg)		Inefficiency (06-08 avg)	
	Coef.	Robust	Coef.	Robust
		Std. Err.		Std. Err.
No Large Hospital within 50 Miles	-0.004	0.007	-0.011	0.062
Hierarchical Partner within 50 Miles	0.021 ***	0.008	-0.057	0.039
Lagged Dependent Variable (02-04 avg)	0.076 *	0.042	0.785 ***	0.084
Staffed Beds (06-08 avg)	5.9E-05	0.000	-4.2E-04	0.000
For Profit	-0.003	0.014	-0.181 **	0.081
Not For Profit	-0.011 **	0.005	-0.030	0.048
Teaching	-0.012	0.012	-0.099	0.105
Medicaid Payer % (06-08 avg)	0.012	0.023	0.814 *	0.418
Medicare Payer % (06-08 avg)	0.022	0.019	0.377	0.295
Per Capita Income 06	4.1E-07	0.000	3.0E-06	0.000
Unemployment Rate (06-07 avg)	-0.002	0.002	-0.005	0.016
Middle Atlantic	-0.005	0.011	-0.083	0.069
East North Central	0.003	0.010	0.030	0.060
West North Central	-0.006	0.010	0.057	0.079
South Atlantic	-0.025 **	0.011	-0.052	0.069
East South Central	8.1E-05	0.013	0.218	0.173
West South Central	-0.022 *	0.011	0.041	0.069
Mountain	0.019	0.012	0.050	0.085
Pacific	0.003	0.011	-0.057	0.113
Intercept	0.016	0.022	-0.233	0.265
	Number of obs = 1007		Number of obs = 1010	
	F( 19, 987) = 2.84		F( 19, 991) = 42.54	
	Prob > F = 0.0000		Prob > F = 0.0000	

\* p &lt; .10

\*\* p &lt; .05

\*\*\* p &lt; .01

Hypothesis four predicts that CAHs with a proximate hierarchical system partner would outperform CAHs with no proximate hierarchical partner. For this analysis CAHs with no hierarchical system partner is the reference category and CAHs with a hierarchical system partner is the comparison group. Once again the results for the model using hospital total margin offer support for the hypothesis but the results from the model using

hospital inefficiency do not (shown in Table 13). Other things equal, CAHs with a proximate hierarchical system partner have a total margin that is 0.027 higher ( $p = .015$ ) than CAHs with no hierarchical partner, but there is no statistically significant hospital inefficiency difference between CAHs with a hierarchical partner and those without.

Table 13. Regression Results for Hypothesis Four

Dependent Variable	Total Margin (06-08 avg)		Inefficiency (06-08 avg)	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
Non-CAH, No Hierarchical Partner	0.005	0.006	-0.085	0.113
Non-CAH, Hierarchical Partner	0.019 *	0.010	-0.160 *	0.094
CAH, Hierarchical Partner	0.027 **	0.011	-0.035	0.067
Lagged Dependent Variable (02-04 avg)	0.076 *	0.042	0.774 ***	0.095
Staffed Beds (06-08 avg)	4.0E-05	0.000	-1.5E-05	0.000
For Profit	-0.004	0.014	-0.174 **	0.085
Not For Profit	-0.011 **	0.005	-0.030	0.048
Teaching	-0.012	0.012	-0.099	0.103
Medicaid Payer % (06-08 avg)	0.013	0.023	0.788 *	0.440
Medicare Payer % (06-08 avg)	0.022	0.019	0.387	0.296
Per Capita Income 06	3.9E-07	0.000	3.5E-06	0.000
Unemployment Rate (06-07 avg)	-0.002	0.002	-0.003	0.017
Middle Atlantic	-0.005	0.011	-0.062	0.079
East North Central	0.002	0.010	0.031	0.062
West North Central	-0.007	0.010	0.054	0.083
South Atlantic	-0.025 **	0.011	-0.030	0.075
East South Central	-3.0E-04	0.013	0.241	0.157
West South Central	-0.023 **	0.012	0.067	0.081
Mountain	0.017	0.011	0.063	0.103
Pacific	0.002	0.011	-0.052	0.109
Intercept	0.016	0.022	-0.241	0.268

Number of obs = 1007	Number of obs = 1010
F( 20, 986) = 2.67	F( 20, 990) = 53.92
Prob > F = 0.0001	Prob > F = 0.0000

\*  $p < .10$

\*\*  $p < .05$

\*\*\*  $p < .01$

### *Hypothesis 5 Results*

Hypothesis five aggregates the four individual measures of fit into a composite measure of fit/congruence, in order to test the fundamental proposition of contingency theory: organizational performance depends on the fit between organizational structure and the environment. The aggregate measure of fit/congruence sums the number of times a hospital was categorized as a “misfit” in the individual fit/congruence measures, and a lower score indicates better fit with the environment and a higher score indicates worse fit with the environment. Composite fit/congruence scores range from 0 to 4. Results for the models that test this hypothesis are reported in Table 14. As with hypotheses one, three, and four, the results for hospital total margin support hypothesis five while the results for hospital inefficiency do not. For hospital total margin, other things equal, a one unit change in the composite fit/congruence score results in a .006 decrease in hospital total margin ( $p = .012$ ). In other words, total margin declines as fit between the hospital and the environment worsens. The results for the Tobit model using hospital inefficiency were not statistically significant.

### *Summary of Hypothesis Testing Results*

The five hypotheses presented in this study test the general proposition that rural hospitals will perform better when their structure better fits the environment. Rather than focusing on the internal structure of the hospital itself, this study focuses on rural hospital system affiliations and how the structure of the system to which rural hospitals belong may affect hospital performance. The centralization of administrative, logistic, and

Table 14. Regression Results for Hypothesis Five

Dependent Variable	Total Margin (06-08 avg)		Inefficiency (06-08 avg)	
	Robust		Robust	
	Coef.	Std. Err.	Coef.	Std. Err.
Composite Fit Measure	-0.006 **	0.002	0.023	0.019
Lagged Dependent Variable (02-04 avg)	0.075 *	0.042	0.782 ***	0.086
Staffed Beds (06-08 avg)	1.3E-05	0.000	-3.0E-04	0.000
For Profit	-0.005	0.014	-0.172 **	0.085
Not For Profit	-0.010 **	0.005	-0.027	0.051
Teaching	-0.011	0.011	-0.101	0.103
Medicaid Payer % (06-08 avg)	0.014	0.023	0.806 *	0.423
Medicare Payer % (06-08 avg)	0.023	0.019	0.374	0.303
Per Capita Income 06	2.8E-07	0.000	3.4E-06	0.000
Unemployment Rate (06-07 avg)	-0.001	0.002	-0.007	0.016
Middle Atlantic	-0.004	0.011	-0.080	0.068
East North Central	0.003	0.010	0.036	0.061
West North Central	-0.006	0.010	0.063	0.086
South Atlantic	-0.023 **	0.011	-0.048	0.068
East South Central	0.001	0.013	0.225	0.169
West South Central	-0.023 **	0.011	0.049	0.071
Mountain	0.013	0.011	0.062	0.095
Pacific	1.9E-04	0.011	-0.046	0.109
Intercept	0.034	0.024	-0.298	0.245
	Number of obs = 1007		Number of obs = 1010	
	F( 18, 988) = 2.89		F( 18, 992) = 48.86	
	Prob > F = 0.0001		Prob > F = 0.0000	

\* p &lt; .10

\*\* p &lt; .05

\*\*\* p &lt; .01

clinical services that are enabled by these system structures are predicted to significantly affect hospital financial performance and productive efficiency. The results from this study, summarized in Table 15, support this prediction.

For the five hypotheses, the results for the OLS models with hospital total margin as the dependent variable are statistically significant at the .05 level and consistent with the

Table 15. Summary of Hypotheses Testing Results

Hypothesis	Comparison	Total Margin		Inefficiency	
		Expected Coefficient	Actual Coefficient	Expected Coefficient	Actual Coefficient
H1: Under conditions of greater resource scarcity, system-affiliated rural hospitals (G2) fit the environment better and will outperform stand-alone rural hospitals (G1)	G2 to G1	+	+	-	-
H2: When proximate to another hospital, system-affiliated rural hospitals with a local partner (G3) will outperform system-affiliated rural hospitals with no local partner (G2)	G3 to G2	+	+**	-	-**
H3: When proximate to larger urban hospitals or RRCs, rural hospitals with hierarchical system relationships (G3) will outperform those with non-hierarchical system relationships (G2)	G3 to G2	+	+***	-	-
H4: Critical Access Hospitals (CAHs) with proximate hierarchical system partners (G4) will outperform CAHs with no proximate hierarchical system partner (G3)	G4 to G3	+	+**	-	-
H5: Rural hospital performance is positively related to the degree of fit between the rural hospital's multi-hospital system structure and its environment	Misfit to DV	-	-**	+	+

\*\* p < .05    \*\*\* p < .01

predicted relationships in four of the five hypotheses. Results of hypotheses two, three, and four indicate that hospital total margin is higher for rural hospitals that have local system partners, rural hospitals that have hierarchical system partners, and CAHs that have hierarchical system partners. The results for hypothesis five support the general proposition that a better fit results in better performance (i.e. higher total margin).

Results for the Tobit models with hospital inefficiency as the dependent variable provided less support for the five hypotheses, with the only statistically significant results coming from the test of hypothesis two. These results indicate that rural hospitals with local system partners are more efficient than rural hospitals that are proximate to other hospitals but have no local system partners. And although the results for the other hypotheses were not statistically significant, the direction of the coefficients was consistent with the predictions in each hypothesis.

There are additional findings related to ownership, Medicaid patient volume, and geographic location that are consistent across all of the models. First, not-for-profit rural hospitals have lower total margins and for-profit rural hospitals are more efficient than local government rural hospitals. Second rural hospitals located in the South Atlantic and West South Central census divisions have lower total margins than rural hospitals in the Pacific census division. Third, rural hospitals with a higher percentage of Medicaid payers were less efficient.

### Supplementary Analysis

Every study involves several methodological decisions regarding study design, sample selection, and analysis techniques that could potentially affect the results of the study. This study is no different, and additional analysis was conducted to determine if some of the decisions made in the study methods affected the study results. Specifically, supplementary analysis was used to test the equal weights assumption in the calculation of the composite fit/congruence measure, to determine if changing the radius for the proximity measures from 50 to 35 miles changed the study results, and to see if the exclusion of the hospitals with AHA estimated values significantly altered the study results. Results of the analysis used to assess the effect of these three decisions on the study are reported in this section.

#### *Testing the Equal Weights Assumption in the Composite Fit Measure*

When the composite fit measure was calculated, hospitals received a score of “1” if they fell into a misfit category in any of the individual fit measures. If a hospital was a

misfit in all four individual measures then it received a score of four, and if the hospital was a misfit in none of the measures then it receive a score of zero. The calculation of the composite fit measure assumes that a categorization of misfit in any of the individual fit measures is equivalent, and each individual fit measure contributes to the composite measure equally. In reality, this assumption may or may not accurately represent the contribution of each misfit category on hospital performance. A misfit in hypothesis one may affect performance more than a misfit in hypothesis two (or three or four).

To determine if the equal weight assumption is valid, an F Test was conducted comparing the restricted model (equation 1.4) which contains the composite fit score ( $F_{i2004}$ ) to the unrestricted model (equation 1.5) which contains indicator variables for each individual misfit category ( $F1_{i2004}$ ,  $F2_{i2004}$ ,  $F3_{i2004}$ , and  $F4_{i2004}$ ). This tests the null hypothesis that the coefficients for the individual misfit categories in are all equal ( $H_0: \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4$ ) versus the alternate hypothesis that at least one of these coefficients is different.

$$\bar{Y}_{i2006-2008} = \beta_0 + \beta_1 F_{i2004} + \beta_2 \bar{H}_{i2006-2008} + \beta_3 \bar{M}_{i2006-2008} + \beta_4 \bar{Y}_{i2002-2004} + \varepsilon_i \quad (1.4)$$

$$\bar{Y}_{i2006-2008} = \beta_0 + \alpha_1 F1_{i2004} + \alpha_2 F2_{i2004} + \alpha_3 F3_{i2004} + \alpha_4 F4_{i2004} + \dots + \varepsilon_i \quad (1.5)$$

The results of this test were insignificant for both hospital total margin ( $F_{3, 985} = 0.48$ ,  $p = 0.6946$ ) and hospital inefficiency ( $F_{3, 989} = 0.78$ ,  $p = 0.5048$ ), providing no support to reject the null hypothesis. Thus there is no reason to reject the equal weights assumption for constructing the composite fit measure.

### *Changing the Radius of the Proximity Measures*

A 50 mile radius was used to generate the proximity measures for this study. As discussed previously, this distance is somewhat arbitrary and was chosen because it is in between distances used in previous studies (Luke, 1992; Desai & Hellinger), and the geographic isolation requirement necessary to qualify for CAH status which is 35 miles. It is possible that hospitals that are 50 miles straight line distance apart may not be close enough to effectively centralize administrative, logistic, and/or clinical services in order to improve performance. For this reason the proximity measures were also calculated using a 35 mile radius and the regressions for each hypothesis were run again with the 35 mile proximity measures.

Changing the radius on the proximity measures to 35 miles significantly changed the results of two of the 10 regression models. All of the results for the regressions with total margin as the dependent variable remained significant, but two of the Tobit model results with hospital inefficiency as the dependent variable changed. Specifically the results for hypothesis three and hypothesis five, which were previously not statistically significant, were now statistically significant at the  $p < .10$  level indicating that hospitals with proximate hierarchical system partners were more efficient than hospitals without hierarchical system partners, and hospital fit is positively related to hospital efficiency.

The results of this supplementary analysis suggest that the results obtained using the 50 mile radius for the proximity measures conservatively estimate the performance affects of local system partners and proximate hierarchical system partners. These results



also provide evidence that a 35 mile radius may be more appropriate for constructing multi-hospital system proximity measures than 50 mile or larger radii.

#### *Exclusion of Hospitals with AHA Estimated Values*

Several hospitals were excluded from the study sample because the values in the AHA annual survey were estimated values rather than reported values. Excluding these hospitals from the study sample may significantly affect the study results because there are significant differences between this group and the study sample in terms of ownership status, geographic location, the likelihood that non-CAHs will have a hierarchical partner and hospital inefficiency in 2002-04. To determine what the effect of excluding these hospitals has on the study results, the regression models for each hypothesis were run again on a sample that contained both the study sample hospitals and the hospitals with AHA estimations.

The inclusion of the hospitals with AHA estimated values changed the results for three of the 10 regression models. The results for hypothesis one changed for both dependent variables and the results for hypothesis four changed for the Tobit model with hospital inefficiency as the dependent variable. For hypothesis one, the results for the analysis of total margin changed from statistically significant to non-significant, and the results for hospital efficiency changed from non-significant to significant. The Tobit results for hypothesis four also changed from non-significant to significant.

The results indicate that the exclusion of the hospitals with AHA estimated values produced more conservative results for the analysis of hospital efficiency, and slightly

less conservative results for the analysis of hospital margin. However, considering that seven of 10 results remained the same and two of the other three estimates were more conservative, there is no reason to second guess the exclusion of the hospitals with AHA estimated values.

### Chapter Summary

This study attempts to analyze the effect of system membership and system structure on hospital performance using a contingency theory approach. Contingency theory stresses the relationship between organization structure and environment, and proposes that a better fit between structure and environment will lead to better performance. Operationalizing this central proposition requires the identification of contingent relationships and the construction of fit/congruence measures to differentiate among hospitals with differing degrees of fit. Organizational performance is then regressed upon the fit/congruence measure(s) to test the study hypotheses.

This chapter discusses the generation of the fit/congruence measures, the generation of other measures that were used to create the fit/congruence measures, and the calculation of the dependent performance measures. Summary statistics were reported for each of these measures and problems encountered with estimating the average hospital total margin and the econometric methods used to overcome these problems were presented.

Regression analysis was used to test the five hypotheses, and statistically significant results which support the stated hypotheses were obtained from five of the 10 regression

models. Supplementary analysis examining the decisions to equally weight misfit categories to construct the composite fit measure, to use a 50 mile radius to construct the proximity measures, and to exclude hospitals with AHA estimated values was also conducted. The results of this analysis indicate that these are sound decisions which produced conservative coefficient estimates for hypothesis testing.

## CHAPTER 6 – CONCLUSIONS

The final chapter of the dissertation presents a discussion of the study findings and relates the findings with the results of previous research. This is followed by a more general discussion of the potential policy and managerial implications of the study results, and how the study methods may inform future empirical work that uses contingency theory. The final two sections present study limitations and suggestions for future research.

### Discussion of the Study Findings

The purpose of this study was to analyze rural hospital performance using a contingency theory framework to account for differences in fit between organizational structure and environmental variables. Generally speaking, the analysis tests the fundamental contingency theory premise that organizational performance is positively related to the fit between organizational structure and the environment. Four contingent pairs linking rural hospital system affiliation to the environment were used to conceptualize fit, and performance was measured in terms of hospital total margin and hospital efficiency. The study results (summarized in Table 15) offer support for the fundamental contingency theory premise, but further discussion is needed to better understand the relationship between the results for hospital total margin and those for hospital efficiency, and to put the results in context considering the existing literature.

*The Relationship Between Hospital Total Margin and Hospital Efficiency*

The first issue that warrants discussion is the relationship between the study results for hospital total margin and those for hospital efficiency, and why the analysis did not yield more statistically significant results for hospital efficiency. The conceptual framework for the study proposes that hospital financial performance and hospital efficiency are closely related and should both be positively affected by system affiliations/structures that allow hospitals to obtain scarce resources and centralize services with system partners. Greater access to resources and increased centralization could lead to economies of scale and/or scope and greater overall productive efficiency, which in turn would increase profitability as indicated by hospital total margin. However, the study results suggest that total margin and efficiency may not be as closely related as depicted in the conceptual framework, since the majority of the results for total margin were statistically significant, but only one of the five results for efficiency was statistically significant. Two potential explanations for this are: that the difference in total margin is caused by a change in efficiency, but the analysis of hospital efficiency is flawed, or the statistically significant difference in total margin is caused by something other than a change in efficiency.

The first possible explanation for the difference between the results for total margin and those for efficiency is that the analysis of hospital efficiency is flawed. This could be caused by a problem with the DEA model that was used to calculate the efficiency scores or a misspecification such as an omitted variable in the Tobit regression model. If either

of these is the case, then the coefficients for the groups of hospitals used to test each hypothesis could be biased, and thus the results of the Tobit regression models would be invalid. Both possibilities will be briefly explored.

The four input and five output DEA model used in this study to calculate the hospital efficiency scores is based on the models used in previous studies that include CAHs in their analysis (Harrison et al., 2009; Butler & Li, 2003; Rosko & Mutter; 2010). These models generally represent the same categories of inputs (capital investments, labor, and operating expenses) and outputs (inpatient and outpatient production) commonly used in hospital efficiency studies (Ozcan, 2008, pg106), but have not been refined and tested as much as the four input and two output model used in studies of non-CAH general hospitals (Ozcan, 2008, pgs 106-108; Nayar & Ozcan, 2008; Ozcan & Luke, 2010; Ozcan & Lynch, 1992; Sikka et al., 2009). Thus the possibility exists that the model used to calculate the hospital efficiency scores in this study may have included something that should not have been included or excluded something that should have been included, resulting in biased efficiency scores. If the efficiency scores are biased in some manner, then this could have affected the results of the Tobit analysis. However, the sensitivity and robustness of various DEA models were tested in two separate studies by Valdmanis (1992) and Ozcan (1992), which noted that efficiency scores for a given group of hospitals were robust and fairly insensitive to changes in the combination of inputs and outputs in the DEA model. Given this, and the fact that the model used in this study is

consistent with previous models used to study critical access hospitals (Harrison et al., 2009; Butler & Li, 2003), the study findings may well be valid.

Another possible problem with the DEA model used in this study is the failure to account for quality differences among hospitals. The DEA model in this study includes inpatient, outpatient, and surgical outputs from different hospitals that may or may not be of equal quality. If these outputs differ substantially in terms of quality, then they may not be comparable, and it is logical to assume that higher quality outcomes may require greater resources (inputs) to achieve. Although the vast majority of hospital DEA efficiency studies do not incorporate quality measures into their models, two recent studies (Nayar & Ozcan, 2008; Mark et al., 2009) include quality and/or patient safety measures as outputs in their DEA models. Nayar & Ozcan (2008) included pneumonia treatment quality indicators in a study of hospital efficiency to determine if there was a tradeoff between technical efficiency and quality, while Mark et al. (2009) used quality and patient safety indicators as outputs in a study of inpatient nursing wards. These studies demonstrate how quality measures may be included in DEA efficiency studies, however work in this area is still in the early stages and the inclusion of quality measures in DEA models is still not common place. Further, although the inclusion of quality measures as outputs in the DEA model may allow a few more hospitals to be identified as efficient, the results from the Nayar & Ozcan (2008) study do not indicate that there is an efficiency-quality tradeoff in hospitals. However, more work is needed in this area and

incorporating quality measures into the DEA model used in this analysis would be worthwhile future research.

If the DEA model used to calculate the efficiency scores is sound, then another possible flaw in the analysis of hospital efficiency is that the Tobit model may be misspecified, perhaps leaving out an important control variable related to hospital efficiency. Omitting an important variable results in biased coefficients for the Tobit regression model if the omitted variable is correlated with any of the other predictor variables in the equation (Wooldridge, 2009, pg 91-92). Thus omitting a variable that is possibly related to hospital efficiency such as hospital nurse staffing ratio or average bed occupancy may bias the coefficients for the groups used in hypothesis testing and alter the study results. While it is possible that an important variable was omitted from the Tobit model in this study, great care was taken to identify the variables to include in the Tobit model. The model is based on the conceptual framework of this study, which is derived from contingency theory, and the variables included in the model were chosen based on Donaldson's (2001) advice for contingency theory empirical work and the results of previous studies that indicate which variables may be important to include in the analysis. So the Tobit model as specified is believed to be the correct population model.

The second and more probable explanation for the difference between the results for total margin and those for efficiency is that the difference in total margin seen in the study results is caused by something other than a change in hospital efficiency. Total



margin is calculated by dividing hospital net income by hospital total revenue, and an increase in hospital total margin means that net income has increased at a faster rate than total revenue. One way to do this is to reduce hospital costs/expenses while holding service production and total revenue constant. Previous studies indicate that this may be accomplished by system hospitals through greater emphasis on cost containment and more efficient staffing (Berry et al., 1987; Trinh & Begun, 1999, McCue, 2007), but greater cost containment and more efficient staffing would affect hospital efficiency as much as they would affect total margin, and the study results indicate that this is not the case. An alternate way to affect hospital total margin without equally affecting hospital efficiency is to increase total revenue while holding expenses and the amount of services provided constant. This could be achieved by raising the price of services and/or changing the mix of payers to raise the average payment for services. This explanation is in line with previous research on system membership and market power (Dranove & Shanley, 1995; Cueller & Gertler, 2005; Melnick & Keeler, 2007) that indicates that system hospitals are able to increase prices more than non-system hospitals. Further, the ability to increase prices may be related to the size of the system cluster (Melnick & Keeler, 2007). Additionally, system membership and affiliation with well-known large proximate hospitals enhances the reputation of hospitals (Dranove & Shanely, 1995) and allows them to attract more managed care patients (Cueller & Gertler, 2005), which may result in a higher average payment rate. So one interpretation of the study results is that system membership and the presence of local system partners increases the market power

and enhances the reputation of rural hospitals, allowing them to increase total revenue by raising prices and/or attracting higher paying patients. However, given that the results for hospital efficiency are consistently in the predicted direction, the significant difference to hospital total margin may be caused by a combination of increased market power and productive efficiency.

#### *Putting the Study Results in Context*

In order to relate the study results to previous research on multi-hospital systems, the general contingency theory proposition that organizational performance is positively related to the fit between organization structure and the environment, will be left behind and each individual hypothesis will be examined separately.

#### *Hypothesis 1*

Hypothesis one examines the effect of system membership on hospital performance while accounting for environmental munificence. Non-system rural hospitals located in low munificence areas are directly compared to system affiliated rural hospitals in low munificence areas. The study results indicate that there is not a statistically significant performance difference in terms of either hospital total margin or hospital efficiency between system and non-system hospitals in low munificence areas. This is consistent with previous research which has failed to identify a performance difference associated with system membership, when system membership is identified with a simple indicator variable. However, the fact that a performance difference is seen in hypotheses two, three, four, and five and not in hypothesis one provides some validation for the

suggestions of Halpern et al. (1992) and Smith & Piland (1990) to use a contingency theory framework to account for economic, structural, and environmental conditions that may determine when system membership is beneficial. The analysis for hypotheses two, three, four, and five accounts for differences in the structure of local system clusters while the analysis for hypothesis one does not. This mix of results not only provides support for the use of contingency theory to analyze system membership, but also indicates that membership in a local system cluster is more important than simply belonging to a national system.

Unlike the other hypotheses in the study, the results of hypothesis one may be influenced by a selection bias by multi-hospital systems in the acquisition of rural hospitals. In hypothesis one system and non-system hospitals are in separate groups, and if multi-hospital systems systematically select better performing hospitals for acquisition, then any observed differences in total margin or efficiency could be the result of this systematic selection. Because the non-experimental study design does not include pre-test measures, this potential selection bias may not be ruled out. However, the results of hypothesis one do not indicate any significant differences between system and non-system hospitals in either high or low munificence areas, so no selection bias is apparent.

### *Hypothesis 2*

The second hypothesis begins to explore the performance effects of local system partners or system clusters and the potential benefits of cluster management (Madison, 2004), which emphasizes the coordination of effort among proximate system hospitals.

Analysis for this hypothesis indicated both a financial and a productive efficiency advantage for rural hospitals with a system partner within 50 miles versus rural hospitals with competitors but no system partners within 50 miles. These results are in line with previous writings that theorized that multi-hospital systems could coordinate and centralize marketing and hospital services to achieve economies of scale and reduce duplication among system hospitals that served the same or overlapping markets (Carey, 2003; Dranove et al., 1996), which are often referred to as hospital clusters (Cueller & Gertler, 2003; Kania, 1993). Although this study relates system structure directly to performance and does not empirically identify the process which the structure enables, these results add to the literature that documents the performance advantages of hospital clusters (Sikka et al., 2009; Trinh et al., 2010).

### *Hypothesis 3*

Continuing with the exploration of local system partners and hospital clusters, the third hypothesis focused specifically on hierarchical structures among proximate system hospitals. Hierarchical system structures and the rational organization of clinical services are part of what was envisioned by the Dawson Report and other early system advocates (Luke, 1992; Donabedian, 1972), and are thought to affect individual hospital efficiency and financial performance (Sikka et al., 2009; Trinh et al., 2010). The study results indicate a clear financial benefit for rural hospitals that are part of a hierarchical system structure, but failed to identify a statistically significant efficiency advantage. So the study results neither contradict nor support previous empirical work that found that

hierarchy among cluster hospitals significantly affected cluster efficiency (Sikka et al., 2009), but they can be interpreted as support for the work of Trinh et al. (2010) that indicates that the performance advantages of hierarchical system structures are realized by the smaller hospital, which receives services from the larger partner.

#### *Hypothesis 4*

Hypothesis four examined the potential moderating effect of CAH status on the performance effect of hierarchical system structure. In the analysis for this hypothesis, CAHs with proximate hierarchical system partners were compared with CAHs with no proximate hierarchical system partners, and a clear financial performance advantage was identified for CAHs with hierarchical partners. And while there is no previous literature that examines the effects of a hierarchical system structure on CAH performance, this performance advantage is consistent with the assumption in the conceptual framework that a hierarchical system structure would be beneficial for CAHs because it would facilitate their patient transfers that occur at a higher rate than non-CAH rural hospitals (Wakefield et al., 2006).

#### *Hypothesis 5*

The final hypothesis in the study returns to the general contingency theory proposition that fit between organization structure and environment is positively related to organizational performance. When organizational performance was regressed upon the composite fit/misfit score, a clear relationship between fit and financial performance was observed. These results support the use of contingency theory as the theoretical

framework for this paper, and demonstrate the relevance of contingency theory as a means to link multi-hospital system structure to hospital performance. Further comments on the theoretical implications of the study results are presented in the following section.

### Implications of the Study Results

The study results have potential managerial and policy implications related to the choices that hospital leaders face and the regulations and reimbursement rates for CAHs under the Flex program. Each of these will be addressed briefly.

#### *Managerial Implications*

The results of this study provide useful information for rural hospital leaders as they face the decision to join a multi-hospital system or remain independent and for multi-hospital system executives as they try to determine what hospitals to acquire and how to structure their system. For rural hospital leaders, perhaps the most important results are those for hypotheses two and three which indicate that there are significant performance advantages to local system partnerships for rural hospitals. Coupled with the lack of significant results for hypothesis one, these results imply that rural hospital leaders should not simply seek to join a system, but should seek to join a local system cluster. Further, if rural hospital leaders have a choice of more than one system to join, they should choose a system with other hospitals in the local area (less than 50 miles away) and preferably one with a larger hospital in the local area. The corollary is true for the multi-hospital system executives. These results suggest that, all else being equal, they should seek to acquire rural hospitals that are proximate to other system hospitals and

manage them as clusters in order to increase the total margin and efficiency of the rural hospital. However, these results only represent the performance of the rural hospital, and there may be other system effects which could negate any potential total margin or efficiency gains in an individual hospital. Thus multi-hospital system executives may have several other considerations when evaluating rural hospitals for potential acquisition.

### *Policy Implications*

The policy implications of this study relate to the federal government's desire to ensure access to care in rural areas through the continued operation of rural hospitals and the administration of the Flex program that governs the designation and reimbursement of CAHs. First, the results of hypothesis one indicate that system membership increases the total margin of rural hospitals in low resource areas, and this may be one way to ensure the continued operation of rural hospitals in these areas. Additionally, the results from hypotheses two and three suggest that incorporating rural hospitals into multi-hospital system clusters further increases hospital total margin. Thus encouraging the acquisition of rural hospitals in low resource areas by multi-hospital systems may be an alternative to the Flex program, which was created to prevent the closure of rural facilities and protect access to health care in rural communities (Dalton et al., 2003). Second, for hospitals already designated as CAHs, the results of hypothesis four suggest that requiring CAHs to form hierarchical partnerships would increase the total margin of CAHs and allow federal policy makers to reduce the reimbursement rates to CAHs and the total cost of the

Flex program, which is currently estimated to cost the federal government \$1.3 billion in Medicare payments each year (Rosko & Mutter, 2010).

The policy implications associated with the results for hospital efficiency are not as clear. The lack of statistically significant results related to hospital efficiency make the identification of efficiency related policy implications difficult, and they neither support nor contradict the conventional wisdom that the rational organization of services by hospital systems should produce economies of scale and scope and result in greater efficiency. Previous studies that reported significant results related to system hospital efficiency examined the efficiency of entire system clusters (Sikka et al., 2009) or focused on process differences rather than structural differences (Trinh et al., 2010). Thus the lack of significant findings for hospital efficiency in this study may reflect the choice to focus on individual rural hospitals rather than entire clusters and/or the failure to account for variations in the process(es) that link hospital structure and performance. Regardless of the reason, the results of this study are not particularly informative for policy makers seeking to increase the efficiency of rural hospitals.

#### Comments on Contingency Theory

In addition to the managerial and political implications of the study results, the theoretical framework and methods used in this study offer important lessons on the use of contingency theory in empirical work.

First, the methods used in this study closely followed Lex Donaldson's (2001, pgs 239-242) recommendations for using contingency theory in empirical work. Of



particular importance are his suggestions to use multiple measures of fit, to ensure that there is a time lag between the measurement of fit and the measurement of performance, and to control for prior performance by including a lagged dependent variable in the analysis. All of these suggestions were incorporated into the study design and methods which produced results that were both statistically significant and consistent with the predictions made in the hypotheses.

Second, the identification of contingent relationships that are used to measure fit is perhaps the most important step in contingency theory empirical work. The traditional formulation of contingency theory focused on the internal structure of a single organization (Woodward, 1965; Lawrence & Lorsch, 1967; Thompson, 1967), using the constructs of complexity, uncertainty, and interdependence to describe the work an organization performs and the constructs of differentiation, centralization, and coordination to describe organizational structure (Scott & Davis, 2007). These are very versatile and traditional constructs that have their origins in bureaucracy theory and industrial organization economics; however, the lack of recent contingency theory-based health services empirical work means that there are few relevant examples for operationalizing these constructs in a health care context. Researchers today may need to put considerable mental effort into identifying the organizational structures and environmental contingencies that best apply to the their research question and the type of organization or organizations that they intend to study. In this study the cooperative efforts among same system hospitals that result in consolidated administrative and

logistic services represent the construct of centralization, while the construct of differentiation is represented by hierarchical system relationships. While these may be valid operationalizations of these constructs, additional theoretical work on how the constructs of centralization, differentiation, and coordination can be applied to the various health services organizations that exist today, would advance the use of contingency theory in health services research.

Third, measuring fit/congruence is a difficult task that is complicated by the measurement of the constituent variables in each contingent pair. Calculating fit/congruence scores for organizations in contingency theory analysis requires matching the values of the organizational structure variable with the values of the variable that represents the environmental contingency. This may be done various ways to include using correlations for continuous variables or simply matching high and low values for dichotomous variables. The four contingent pairs used in this study contained a mix of continuous and dichotomous variables, which made calculating the fit/congruence scores difficult. In order to simplify the process, all of the variable measures were converted to dichotomous measures and 2x2 matrices were constructed to categorize the hospitals in the study sample. There is nothing inherently wrong with this technique, but some of the explanatory power of the continuous variables was most likely lost and the fit/congruence measures as calculated in this study do not identify an iso-performance line (Donaldson, 2001, pgs 192-193), which identifies different combinations of the structure and contingency variables which produce the same performance. This may be viewed as a

limitation to this study, but also serves to illustrate how difficult measuring fit/congruence may be.

The final comment on contingency theory concerns the importance of focusing on the relationship between fit/congruence and performance. The central proposition in contingency theory is that the fit between organization structure and the environment affects performance. Therefore, in contingency theory research the fit/congruence score is the primary explanatory variable in the analysis of performance, and the individual measures of structure and environment used to calculate the fit/congruence score are only used as control variables in the analysis. Unfortunately, most recent health services research with a contingency theory framework misses this core idea and applies the theory incorrectly (Mark et al., 2007; Mark et al., 2008; Bacon et al., 2009) by regressing performance directly upon the structural variable(s), the environmental variable(s), and/or an interaction term of the two. Based on Donaldson's recommendations (2001), the analysis in this study focuses on the relationship between fit and performance. Hopefully, the methods in this study offer an example of how to correctly apply contingency theory in empirical research, and the significant findings obtained will encourage others to use contingency theory to study organizational performance.

#### Study Limitations

As with any research study, there are limitations to the design and methods of this study which should be noted and potentially addressed in future research. Three potential limitations were mentioned at the end of the methods chapter: non-experimental design,

possible selection bias/endogeneity, and measurement error in the AHA survey variables. This section will expand on some of those remarks and then highlight two other limitations which should be considered.

First, of the three limitations mentioned at the end of the methods chapter, the non-experimental design of the study is the most important one. As previously stated, measurement error in the AHA survey variables (Mullner & Chung, 2002) may be present, but the survey is widely used in health services research and there is a large body of research that has produced consistent results using the survey data, so AHA survey measurement error is not a great concern. Additionally, while the existence of a potential selection bias related to hospital system membership cannot be ruled out in this study, it would have a minimal effect on the study results. Only hypothesis one compares system hospitals to non-system hospitals. In the other hypotheses the comparison groups contain a mix of system and non-system hospitals, so a selection bias related to system membership would affect all groups equally. Further, the inability to rule out a potential selection bias is related to the study design, and the inability to gather baseline performance measures prior to any of the hospitals joining systems. So the primary limitation mentioned in the methods chapter is that of a non-experimental design.

A non-experimental post-test design limits a researcher's ability to make causal inferences (Trochim & Donelley, 2008), and studies which use non-experimental post-test designs are open to threats to internal validity such as selection bias, history threats, and/or maturation threats. In the social sciences true experiments cannot normally be

conducted because study participants cannot be randomized to control and treatment groups. When this is the case, the best study design for making causal inferences and controlling threats to internal validity is a natural experiment or quasi-experiment which involves pre-test and post-test measures for both a treatment group and a comparison group. Modifying this study so a quasi-experimental design could be used would improve this study and will be discussed further in the next section. As currently designed, this study produced significant findings that add to the body of literature on the effects of multi-hospital system membership and hospital clusters. A lagged dependent variable is used to control for prior performance as well as unobserved hospital specific characteristics, and the relationship between organization structure / environmental fit and performance is isolated. However, the study design prevents any causal inference from being formally associated with this relationship.

The second study limitation is the crudeness of the measurement of fit/congruence in the study. In the previous section some comments were made about the difficulty of measuring fit/congruence and the inability in this study to identify an iso-performance line for each measure of fit/congruence. This difficulty does not invalidate any of the fit/congruence measures used in the study or the results that were obtained from the analysis of performance, but it is a limitation of this study which could be improved in future research. The fit/congruence measures could be refined and improved in order to improve the fidelity of the analysis. Rather than using categorical measurements of fit/congruence, if continuous measurements were developed then the analysis of

performance would produce coefficients that may indicate how close system hospitals should be in order to gain an advantage or what size of a system cluster is most advantageous. And perhaps better fit/congruence measurements may be able to refine the analysis of hospital efficiency enough to produce statistically significant results.

The third and final limitation of this study is its inability to identify the process or processes that link fit to performance. However, this is really more of a limitation of contingency theory than it is a limitation of this one study. Contingency theory links the fit between organization structure and environment to organization performance, but it does not identify how a better fit results in better performance. In this study it is assumed that system membership allows rural hospitals in low resource areas to obtain critical resources to operate their hospitals, and that proximity to other system hospitals results in cooperative effort to centralize services and reduce duplication. But these are only assumptions about the processes that underlie the relationship between structure and environment. None of the empirical tests in this study validate those assumptions, and it is possible that the performance differences identified in the analysis are related to some other process. The study results simply show that there are significant performance differences related to the fit between organization structure and environment. Identifying the underlying processes that cause that performance difference is an issue for future research, and will be discussed in the next section.

### Suggestions for Future Research

To close this study, three suggestions for future research are made which are related to the study limitations previously discussed. The first suggestion for future research is to alter the design of this study to a quasi-experimental design by selecting a sample of hospitals that change system membership. The current study used a sample of rural hospitals with constant system membership and CAH status for the study period. This sampling strategy maximized the study sample and increased external validity and generality of the results, but resulted in a non-experimental design that limited the ability to make causal inference. By focusing on hospitals that switched system membership/CAH status, the study design can incorporate both pre-test and post-test measures to better control threats to internal validity and make causal inference. The fit/congruence measures could be taken one year prior and one year after a hospital changed system/CAH status, and the change in fit/congruence could be related to hospital performance. Looking at the current study sample and the hospitals that were excluded from the sample (Table 2), there were 80 hospitals that changed system membership status and 96 hospitals that changed CAH status during the period 2004 to 2008. However, what is not shown in that table is when each of those hospitals changed either system membership or CAH status. In order to ensure a sufficient time lag between the change in fit and the measurement of hospital performance, the study period may have to be expanded to identify a sufficiently large study sample.

The second suggestion for future research is to refine the analysis of hospital efficiency, in order to improve the results of this analysis. There are several ways in which this may be done. First, the DEA model and/or the hospitals in the study sample may be modified to improve the DEA scores. Although Valdmanis (1992) has shown that DEA efficiency scores are fairly robust to slight changes in model inputs and outputs, there may be room for improvement to the current model since CAH DEA models are not as common as non-CAH general hospital models. Additionally, the scores produced by any DEA model depend on the organizations that are in the sample. The sample used in this study contained both CAH and non-CAH hospitals as well as micropolitan and non-core hospitals which on average are significantly different in size. Calculating DEA scores and conducting efficiency analysis with these hospitals in one sample may be incorrect. Separating these hospitals into smaller, more homogenous groups may produce more accurate efficiency scores and improve the fidelity of subsequent analysis. Another way to refine the efficiency analysis is to improve the fit/congruence measures as mentioned in the study limitations. Refining the measures to use continuous constituent measures rather than categorical ones may improve the analysis. Finally, the efficiency analysis may be improved by identifying other important control variables. Qualitative research may be used to more accurately identify the organizational variables that contribute to hospital efficiency, and then these may be used to improve the efficiency analysis.



The final suggestion for future research is to try and identify the processes that underlie the relationship between fit and performance. Path analysis as employed by Trinh et al. (2010) is a possible example of how this could be done. Fit/congruence could be measured at one point in time ( $t$ ) and then a process like clinical service sharing could be measured at a point in the future ( $t + 1$ ) and then organization performance could be measured even farther in the future ( $t + 2$ ). This would allow the researcher to validate the assumptions about what process a better fit enables. Clinical service sharing is used as an example here because it can be calculated from the AHA survey data and has been used in previous research (Bazzoli et al., 1999; Trinh et al., 2008; Trinh et al., 2010), but other processes like logistic service consolidation, the creation of central imaging facilities that service multiple hospitals, administrative service consolidation, and the use of common IT systems may be other important processes to include in this analysis which would most likely involve primary data collection.

### Conclusion

Given the lack of research focused on the effects of rural hospital system membership and the infrequent use of contingency theory in recent health services research, this study offers important findings and methodological examples to the field of health services research.

The results of the empirical analysis indicate that system membership offers clear financial performance advantages and some productive efficiency performance advantages for rural hospitals in low munificence areas and for rural hospitals that close

to other system hospitals. These study results do not reflect a universal relationship between system membership and hospitals performance that is uniformed for all rural hospitals. Instead they demonstrate that the benefits of system membership are dependent upon the fit between the structure of the system relationship and the environment. The significant findings related to hospital total margin and hospital efficiency may help rural hospital leaders, multi-hospital system executives, and policy makers concerned with access to care in rural areas understand when and where rural hospital system affiliation is most appropriate / desirable.

Methodologically, this study is an important example of the application of contingency theory in empirical research. Contingency theory was specifically developed to study differences in organizational performance, but it has fallen by the wayside as newer and more popular organization theories have emerged. Although the methods contained in this study are not perfect, by following the suggestions of Lex Donaldson (2001) this study illustrates how significant and relevant findings may be obtained by focusing on the relationship between fit and performance. This is important considering the heterogeneity of organizations and environments by which and in which health services are delivered. Contingency theory could be a very useful performance analysis tool in this time of fiscal uncertainty and ballooning health care expenditures.

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## APPENDIX 1 – CORRELATION MATRIX

	H1G1	H1G2	H1G3	H1G4	H250G1	H250G2	H250G3	H350G1	H350G2
H1G1	1								
H1G2	-0.1387	1							
H1G3	-0.1826	-0.1371	1						
H1G4	-0.1443	-0.1084	-0.1426	1					
H250G1	0.0331	0.0004	-0.0041	0.0431	1				
H250G2	0.2542	-0.3112	0.2627	-0.3364	-0.2209	1			
H250G3	-0.2700	0.3176	-0.2670	0.3298	-0.0917	-0.9509	1		
H350G1	0.0005	-0.0356	0.0817	0.0800	0.3007	0.0184	-0.1141	1	
H350G2	0.1436	-0.1972	0.0751	-0.2224	-0.1986	0.4920	-0.4394	-0.6607	1
H350G3	-0.1875	0.2949	-0.1854	0.2038	-0.0637	-0.6603	0.6943	-0.2117	-0.5938
H450G1	0.1078	-0.0505	-0.0836	-0.1213	0.0428	0.2031	-0.2209	0.0978	0.1826
H450G2	-0.1210	0.2867	-0.1197	0.0568	-0.0411	-0.4263	0.4483	-0.1367	-0.3833
H450G3	0.0328	-0.1676	0.2179	-0.0317	0.0051	0.2877	-0.2953	0.0604	0.2588
H450G4	-0.1322	0.1184	-0.1307	0.2131	-0.0449	-0.4654	0.4895	-0.1493	-0.4186
H5fit50	0.4711	-0.3096	0.1660	-0.2745	-0.1517	0.7762	-0.7444	-0.2307	0.7380
Inefficiency 0204	-0.0467	-0.1499	0.2102	0.1128	0.0441	0.0976	-0.1136	0.1422	-0.0334
Total Margin 0204	0.0130	-0.0138	-0.0514	0.0185	0.0062	-0.0030	0.0011	0.0127	-0.0034
Average Beds 0608	0.0169	-0.0111	-0.0439	0.0118	0.0071	0.0047	-0.0071	0.1348	-0.0583
Medicaid Percent 0608	0.1767	-0.0264	-0.0522	-0.0198	0.1086	0.0147	-0.0494	0.1870	-0.0943
Medicare Percent 0608	-0.0421	0.0801	-0.0457	-0.0630	-0.1002	-0.0100	0.0420	-0.2537	0.1443
For Profit	-0.0476	0.1565	-0.1091	-0.0063	0.0122	-0.0373	0.0343	-0.0107	0.0155
Local Government	0.1079	-0.1520	0.0926	-0.1048	0.0552	0.2017	-0.2235	0.0500	0.1099
Not for Profit	-0.0805	0.0666	-0.0334	0.1056	-0.0603	-0.1776	0.2004	-0.0433	-0.1155
Teaching	-0.0108	-0.0410	0.0122	0.0363	-0.0185	0.0322	-0.0269	0.0192	-0.0065
New England	-0.0766	-0.0575	0.2278	-0.0217	-0.0260	0.0927	-0.0864	-0.0280	0.0586
Middle Atlantic	0.0130	-0.0296	-0.0853	-0.0503	-0.0293	0.0655	-0.0576	-0.0581	0.0720
East North Central	0.0075	-0.0144	-0.1039	-0.0969	-0.0620	-0.0372	0.0577	-0.1009	0.0057
West North Central	-0.1836	-0.1521	0.2226	0.2818	-0.0271	-0.0748	0.0850	0.0146	-0.0262
South Atlantic	0.1067	0.0483	-0.0984	-0.0512	-0.0468	-0.0107	0.0257	-0.1471	0.1070
East South Central	0.1701	0.1945	-0.1243	-0.0943	-0.0460	-0.0177	0.0326	-0.1265	0.0864
West South Central	0.0304	-0.0020	-0.0462	-0.0911	-0.0478	0.0818	-0.0684	-0.0121	0.0403
Mountain	-0.0329	-0.0163	0.0619	0.0316	0.2071	0.0245	-0.0907	0.3375	-0.1806
Pacific	0.0381	0.1114	-0.0981	-0.0475	0.1248	-0.0542	0.0157	0.1300	-0.1435

	H350G3	H450G1	H450G2	H450G3	H450G4	H5fit50	Inefficiency 0204	Total Margin 0204	Average Beds 0608	Medicaid Percent 0608
H350G3	1									
H450G1	-0.3425	1								
H450G2	0.6456	-0.2211	1							
H450G3	-0.4017	-0.7228	-0.2593	1						
H450G4	0.7049	-0.2414	-0.0866	-0.2831	1					
H5fit50	-0.7135	-0.1173	-0.4606	0.6391	-0.5030	1				
Inefficiency 0204	-0.1089	-0.3098	-0.1833	0.3820	0.0282	0.1689	1			
Total Margin 0204	-0.0092	0.078	0.0065	-0.0692	-0.018	-0.0274	-0.0376	1		
Average Beds 0608	-0.0687	0.4198	0.0497	-0.3587	-0.1358	-0.1654	-0.0273	0.0227	1	
Medicaid Percent 0608	-0.0777	0.0230	-0.0533	0.0348	-0.0518	0.0360	0.3091	-0.0006	0.4655	1
Medicare Percent 0608	0.0841	0.0445	0.0921	-0.1052	0.0242	-0.0029	-0.4311	0.0273	-0.3964	-0.7929
For Profit	-0.0086	0.1393	0.0520	-0.1295	-0.0595	-0.0764	-0.0943	0.0232	0.0622	-0.0639
Local Government	-0.1966	-0.0660	-0.1302	0.2089	-0.1356	0.2407	0.1881	-0.0029	-0.1490	-0.0041
Not for Profit	0.1967	-0.0085	0.1000	-0.1364	0.1637	-0.1952	-0.1345	-0.0094	0.1130	0.0374
Teaching	-0.0121	0.0964	-0.0053	-0.0851	-0.0108	-0.0289	-0.0548	0.0132	0.1675	-0.0388
New England	-0.0464	-0.0216	-0.0282	0.0551	-0.0343	0.0587	-0.0521	-0.1112	-0.0112	0.0232
Middle Atlantic	-0.0314	0.1815	0.0026	-0.1538	-0.0434	-0.0062	-0.0925	0.0052	0.2516	0.0603
East North Central	0.1007	-0.0609	0.0178	-0.0147	0.1149	-0.0158	-0.1032	0.0685	-0.0062	-0.0122
West North Central	0.0184	-0.2426	-0.1214	0.2229	0.1368	-0.0020	0.3045	-0.0315	-0.0884	-0.0821
South Atlantic	0.0184	0.1346	0.0666	-0.1447	-0.0379	0.0106	-0.1329	-0.0153	0.1582	0.0519
East South Central	0.0232	0.1091	0.0838	-0.1234	-0.0476	0.0278	-0.0935	0.0160	0.0902	0.0932
West South Central	-0.0396	0.1272	0.0340	-0.0949	-0.0832	0.0172	-0.0904	-0.0393	-0.1417	-0.1788
Mountain	-0.1267	-0.0009	-0.0681	0.0941	-0.1021	-0.0333	0.1124	0.0642	-0.0325	0.1321
Pacific	0.0475	-0.0881	0.0738	0.0509	-0.0065	-0.0452	-0.0264	0.0140	-0.0630	0.0516

	Medicare Percent 0608	For Profit	Local Government	Not for Profit	Teaching	New England	Middle Atlantic	East North Central	West North Central
Medicare Percent 0608	1								
For Profit	0.0923	1							
Local Government	-0.0596	-0.2239	1						
Not for Profit	0.0099	-0.3047	-0.8601	1					
Teaching	0.0366	-0.0053	-0.0521	0.0537	1				
New England	0.0220	-0.0502	-0.1181	0.1417	0.0233	1			
Middle Atlantic	-0.0018	-0.0368	-0.1385	0.1546	-0.0255	-0.0358	1		
East North Central	0.0391	-0.0985	-0.1169	0.1658	0.0784	-0.0757	-0.0853	1	
West North Central	-0.0799	-0.1043	0.1075	-0.0505	-0.0244	-0.1092	-0.1230	-0.2604	1
South Atlantic	0.0157	0.1189	-0.0449	-0.0184	-0.0135	-0.0572	-0.0644	-0.1363	-0.1967
East South Central	0.0227	0.1502	0.0054	-0.0839	-0.0400	-0.0562	-0.0633	-0.1339	-0.1932
West South Central	0.1992	0.1048	0.1213	-0.1734	0.0267	-0.0809	-0.0911	-0.1928	-0.2782
Mountain	-0.2005	-0.0172	-0.0050	0.0138	-0.0422	-0.0592	-0.0666	-0.1411	-0.2035
Pacific	-0.0365	-0.0650	0.0395	-0.0045	0.0069	-0.0412	-0.0464	-0.0981	-0.1416

	South Atlantic	East South Central	West South Central	Mountain	Pacific
South Atlantic	1				
East South Central	-0.1011	1			
West South Central	-0.1456	-0.1431	1		
Mountain	-0.1065	-0.1047	-0.1507	1	
Pacific	-0.0741	-0.0728	-0.1048	-0.0767	1

Key to Variables in the Correlation Matrix	
H1G1	Low Resource Munificence, Non-System Hospitals
H1G2	Low Resource Munificence, System Hospitals
H1G3	High Resource Munificence, Non-System Hospitals
H1G4	High Resource Munificence, System Hospitals
H250G1	Hospitals Not Within 50 Miles of Any Other Hospital
H250G2	Hospitals Within 50 Miles of Another Hospital but No Local System Partner
H250G3	Hospitals Within 50 Miles of Another Hospital and A Local System Partner
H350G1	Hospitals Not Within 50 Miles of a Large Hospital
H350G2	Hospitals Within 50 Miles of a Large Hospital but No Hierarchical System Partner
H350G3	Hospitals Within 50 Miles of a Large Hospital and A Hierarchical System Partner
H450G1	Non-CAH Hospital with no Hierarchical System Partner
H450G2	Non-CAH Hospital with a Hierarchical System Partner
H450G3	CAH Hospital with no Hierarchical System Partner
H450G4	CAH Hospital with a Hierarchical System Partner
H5fit50	Composite Fit/Congruence Measure
Inefficiency 0204	Hospital Inefficiency Score Average for 2002 to 2004
Total Margin 0204	Hospital Total Margin Average for 2002 to 2004
Average Beds 0608	Average Staffed Beds for 2006 to 2008
Medicaid Percent 0608	Average Medicaid Payer Percentage for 2006 to 2008
Medicare Percent 0608	Average Medicare Payer Percentage for 2006 to 2008
For Profit	Hospitals with For-Profit Ownership
Local Government	Hospitals Owned by Some Local Government Entity
Not for Profit	Hospitals with Non-Government Not-for-Profit Ownership
Teaching	Hospitals with a Residency Program
New England	Hospitals in the New England Census Division
Middle Atlantic	Hospitals in the Middle Atlantic Census Division
East North Central	Hospitals in the East North Central Census Division
West North Central	Hospitals in the West North Central Census Division
South Atlantic	Hospitals in the South Atlantic Census Division
East South Central	Hospitals in the East South Central Census Division
West South Central	Hospitals in the West South Central Census Division
Mountain	Hospitals in the Mountain Census Division
Pacific	Hospitals in the Pacific Census Division

## VITA

Mark Doughton Swofford was born on June 27, 1970 in North Wilkesboro, North Carolina. He graduated with a Bachelor of Science in Biology from Davidson College in 1992, and earned a Masters Degree in Health Care Administration from the U.S. Army Baylor program in 2003.

He was commissioned as a Medical Service Corps officer in the United States Army in 1992, and has served on active duty for over 19 years. His previous assignments include tours of duty as Deputy Commander of Administration, 86<sup>th</sup> Combat Support Hospital, Mosul, Iraq; Executive Officer, 86<sup>th</sup> Combat Support Hospital, Baghdad, Iraq; Deputy Director of Clinical Operations, Southeast Regional Medical Command; Medical Company Commander, 215<sup>th</sup> Forward Support Battalion, 1<sup>st</sup> Cavalry Division, Fort Hood, Texas; Executive Officer, U.S. Army Health Clinic; Butzbach, Germany; Medical Platoon Leader, 2-67 Armor Battalion, 1<sup>st</sup> Armored Division, Friedberg, Germany. He is a Fellow in the American College of Health Care Executives and received the 2004 Regent's Award for region eight.

He is married to the former Monica Jane Lide of Winston-Salem, North Carolina, and is the proud father of three children, Jack (13), Sam Henry (9), and Emma (7). He and his family currently live in Chester, VA, but will relocate to Fairfax, VA in August 2011, where he will work in the office of the Army Surgeon General.